

**A TYPOLOGICAL
INVESTIGATION
OF MILL BUILDINGS
IN GREECE**

KONSTANTINA G. DEMIRI

Dipl. Arch. Eng. (Aristotle University of Thessaloniki)

Ph.D. THESIS

**DEPARTMENT OF ARCHITECTURE
UNIVERSITY OF EDINBURGH**

1986



DECLARATION

I declare that this thesis is my own original work

K.G.DEMIRI

CONTENTS

ABSTRACT	7
ACKNOWLEDGEMENTS	10
GENERAL INTRODUCTION.....	13
CHAPTER 1: <u>THE GENERAL BACKGROUND</u>	
Introduction	23
1.1. The socioeconomic conditions.....	25
1.2. The basic characteristics of the manufacturing industry	32
1.3. The morphology and characteristics of the textile sector	42
CHAPTER 2: <u>THE NATURE OF MILLS AND IMMEDIATE INFLUENCES ON THEIR DESIGN</u>	
Introduction	53
2.1. Basic stages of the production process- The machinery	54
2.2. Environmental conditions: their potential effect on design	69
2.3. Legislation for building control: its influence on design	78
2.4. Building Materials	83
CHAPTER 3: <u>THE SURVEY</u>	
Introduction	89
3.1. Conditions of the field work- Characteristics of the sample	91
3.2. The description of the evolution of mills * Formal language	94
* Constructional system	131
* Articulation of spaces	141
3.3. Conventional approach and typological analysis	149
CHAPTER 4: <u>THEORY AND APPLICATION OF TYPOLOGICAL ANALYSIS</u>	
Introduction	156
4.1. The notion of type and the relationship between typology and classification	158
4.2. The notion of type in architectural thought. 164 * Early views of the concept of type....	164
* Type and metaphoric imitation.....	172
* Classificatory notion of type.....	173
* Type and standardization.....	177
* Analytical and generative typology ...	179
* Typology and history	188
* Typology and design	193
* Typological analyses.....	196
4.3. The concept of type in various disciplines	199
4.4. The practical application of typological method in historical analysis	209

CHAPTER 5: THE TYPOLOGY OF MILLS
 Introduction216
 5.1. The procedure for the identification of
 the types of mills217
 5.2. Description of mill-types229
 5.3. Notes on the evolution of types237
CHAPTER 6: THE INTERPRETATION OF MILL-TYPES244
CHAPTER 7: A DISCUSSION OF THE THEORETICAL ISSUES
 INVOLVED IN THE TYPOLOGICAL APPROACH269
GENERAL CONCLUSIONS286
NOTES & REFERENCES293
BIBLIOGRAPHY321
APPENDIX(separate volume)

ABSTRACT

The thesis is concerned with the study of the evolution of mill buildings in Greece from the end of the nineteenth century using a typological approach. It is also a case-study in development and evaluation of the use of the typological method of analysis in application to a single building class.

Mills, as rather ordinary utilitarian buildings, can only be subjected to conventional stylistic analysis with great difficulty because their designers are unknown or, if known, in most cases do not adhere to any known architectural school of thought, and because most of the buildings are individually of no special stylistic or architectural intent.

The description of a sample of 57 mills according to their formal language, constructional system and articulation of spaces shows the inadequacy of the conventional descriptive approach in handling the large number of cases and in making inductive generalizations concerning their relationships, origins and meanings. An analysis of the evolution of the uses of typology in architecture leads to a clarification of the conceptual framework of the typological approach. The meaning of type is defined and type is distinguished from class.

A procedure is developed for the identification of the types of a set of buildings. The sample of the 57 mills is typologically analysed and seven types are identified. The interpretation of the types is made using factors which are either extrinsic to design (socioeconomic conditions, the nature of

the production process, environmental conditions, legislation, technical and material means of construction), or intrinsic to them and related to architectural ideology.

The case-study of the sample of mill buildings provides answers to a number of theoretical issues regarding the ontogeny of types and the potential of typological analysis as a descriptive tool in architecture.

ACKNOWLEDGEMENTS

This thesis has been conceived and developed in the Department of Architecture, University of Edinburgh, under conditions which I believe are very motivating for scientific work.

Above all, I would like to express my sincere gratitude to my supervisor, Professor C.B.Wilson, for his extremely valuable remarks, stimulating criticism and friendly encouragement. I would also like to thank Senior Lecturer M.Birkhans, my second supervisor; I have found his suggestions and critical comments of considerable help.

I am very much obliged to Mr. K.Beis, ex-Director of the Textile Sector in the Ministry of Industry. Without his support the collection of the material of the survey would have been impossible. I have received great support from many other people for the collection of the empirical material of the thesis, which has been done under exceptionally difficult conditions. They will forgive me for not being able to name them individually here, but their help is sincerely appreciated.

I would also like to express my thanks to Professor J.D. Triantafyllidis and my colleague at the University of Thessaloniki, Ass.Professor A.D.Kotsiopoulos for their help and moral support.

I also thank Ms S.Dolgiras and mainly Ms A. and Ms T.Vlahonasios for their valuable editing. I am grateful to Ms E.Tamkatzoglou who typed this thesis and to Ms V.Dermentzoglou for her help in the design of the drawings.

Finally, I want to thank my parents for their moral and financial support and also my husband Prof. V.Droucopoulos whose advice and assistance on some aspects of this work have been invaluable.

Lastly, I would like to thank my six-month old son Spiros, whose birth has substantially contributed in making the timely completion of my thesis a most imperative task!

GENERAL INTRODUCTION

FORMULATION OF THE PROBLEM

This thesis deals with the description and interpretation of the historical evolution of mills in Greece through a typological approach. An old notion of type in architecture is used which is developed and enriched with ideas from other fields of enquiry. Thus, the aim of the research is twofold: to study the evolution of mills in Greece, and to develop and assess the typological method of analysis.

The choice of mills was made for a number of reasons. The first was subjective and followed from my involvement in the Department of Architecture of the Aristotle University of Thessaloniki in the study of planning and designing factories between 1977 and 1981.

The other reasons are related to the nature of mills as a set of buildings suitable for the application and assessment of typological analysis. Mills form a class of buildings which has not been subjected to historical description so far. They have a history of nearly a century, since textiles is one of the oldest branches of Greek industry, and thus constitute an appropriate case for historical analysis. Finally, factories in general and mills in particular are ordinary utilitarian buildings and would not be the object of a conventional stylistic analysis.

The emphasis on methodology is the result of a number of considerations related to the ways in which historical analyses are usually conducted. Every historical study deals with: the nature of the descriptive material, the way of

organizing descriptive data and the process of description. Architectural history has been predominantly concerned with certain building classes: public buildings and houses especially those designed by architects. Furthermore, it generally deals with individual masterpieces which represent a small proportion of the built environment. J.P. Bonta, referring to the way historians describe modern architecture, points out that they usually use as examples small buildings such as villas, shops or pavillions which although they "... appear important from the points of view from which historians conduct their argument, they only represent an insignificant proportion of total architectural production"¹. It is quite legitimate for historians to concentrate on great architects or seminal buildings. However, when one is interested in describing and explaining the evolution of the architectural trends in a certain area in general or the evolution of the architecture of a particular class of buildings, he should embrace a representative sample of the entire built environment irrespective of the designer and the architectural importance of the buildings. This consideration reflects the view that the architecture of an epoch is illustrated not only in certain buildings but in the totality of the built environment; this is constituted of buildings which are marked, in the majority, by borrowed traits and which are very rarely masterpieces.

It is a basic concern of this work to concentrate on a sample of buildings which represents approximately 55% of the whole set of mills in Greece. The choice has been

made on the basis of three non-architectural criteria which are analysed in section 3.1. These are: the area where the mill is built, the size of the firm and the year of its establishment.

Another important point is the way the descriptive material is organized in conventional historical analyses: buildings are analysed by styles, by schools or by architects. All these categories, which allow architectural historians to group the material they investigate, derive from the idea that the architecture of an epoch can be adequately described by a few masterpieces and is expressed through one style or a limited range of styles. By 'style' is meant a peculiar, pervasive and vigorous formal language governing a group of architectural works whose architects are regarded as responsible for the dynamics of style. These categories seem to be inadequate when one is dealing with ordinary buildings which are not masterpieces, their designer is usually unknown, if he is not famous, and their form does not seem to occupy a position within the framework of any stylistic system.

Some historical studies regard buildings isolated from the environment and are innocent of the main drawings (site plan, plans, sections, elevations). Descriptions are mainly based on photographs taken from certain view points and at their worst are mere facadism. J.H.Bonta, arguing about the conflicting interpretations in architectural criticism and the differences between the expressive systems of historians and critics, points out that the photographs which appear in the books give a fragmented image of the building and are

selected to correspond to the position of the writer². P. Frankl in his book 'Principles of Architectural History'³ avoided the piecemeal approach by establishing four descriptive categories for the analysis of architecture. The most important of these is the one called 'visible form' which refers to the kinetic experience of the observer who moves around and through a building and obtains a single image of the whole building and not isolated fragments of it. It is a basic premise of the thesis to consider the buildings as whole entities and thus to use for the survey only those mills whose complete drawings and other information are available.

If these criticisms of conventional historical approach are accepted a search must be made for another, more effective one, for the study of mill buildings. The thesis employs the typological method for the analysis of mills since it is much more comprehensive than conventional approach and also because it is appropriate for the nature of the descriptive material. Mills are not open to conventional analysis according to styles or architects because their designers are either unknown or have not acted within the framework of any known architectural school of thought. Thus, the research is based on a quite large amount of the existing mills (except those for which data is not available). The focus on buildings leads to a mass of data which necessitates a new method of analysis and interpretation.

Although the notion of type has its origins in the architectural writings of the eighteenth century, the relevant

literature on typology lacks any systematic and integrated inquiry into the theory and application of the typological analysis.

Additionally there is an ambiguity as regards the meaning of the notion of type which is often confused with the concept of class. Furthermore, architectural writings dealing only with typological analysis do not have any explicit basis in a coherent conception of type and often verge towards an approach which has more the character of classification than of typology. It is a central argument of the thesis that a distinction has to be made between type and class and therefore between typology and classification; this is very tenuous but it has important methodological implications. I shall argue, in due course, that the difference between the two concepts underlines the opposition between an approach which treats buildings holistically and seeks to examine the ideas beneath the observable form, and an approach which fragments the buildings and is concerned particularly with their form.

The concept of type in architecture as a descriptive tool has its origins in the taxonomic works of the biological sciences and those of archaeology. In both of these and mainly in the latter the notion of type, its use for description and the methodological issues involved have been debated in length. A number of views which have been elaborated in archaeology at the levels of both theory and practice are applicable and useful in the study of architectural phenomena. It is a dominant aim in the thesis to develop a typological method of analysis which can be asses-

sed through a particular case-study by extracting and using, within an architectural context, ideas worked out in archaeology and biology. Furthermore, it seeks to set out and subject to critical analysis a number of fundamental issues concerning the function of types in architecture based upon the conclusions of the case-study.

STRUCTURE OF THE THESIS

In chapter 1 ('The socioeconomic framework') an overall analysis of the evolution of the socioeconomic conditions in Greece from the end of nineteenth century until today is given with an emphasis on their impact on the development of industry and of textiles in particular. This is mainly an introductory chapter giving the general framework within which Greek mill buildings evolved. Additionally, it provides for the non-Greek reader a basis on which he can more easily locate and comprehend the particulars of the survey.

In chapter 2 ('The nature of mills and immediate influences on their design') four factors which influence mill design are described: the production process and the machinery used, the environmental conditions in the factory - mainly those related to noise, ventilation and lighting -, the industrial statutory framework with an emphasis on workers' health and safety regulations and finally the available building materials together with the conditions in the construction industry. The above factors are extrinsic to designers and industrial clients and constitute a picture-frame within which design takes place, and affects all mills in more or less the same way. The factors which are intrinsic to

designers and are determined by his experience and scientific knowledge acquired by his professional life and education are presented in Chapter 6 interwoven with the interpretation of the types of mills.

Chapter 3 ('The Survey') deals with the description of the sample of 57 factories of the thesis. It opens with a brief presentation of the conditions under which the survey took place and also of the characteristics of the sample. At its centre is the description of mills in terms of their formal language, constructional system and articulation of spaces. The chapter closes with a brief criticism of the potentials and limitations of the description and opens up the discussion of the typological approach.

In chapter 4 ('The theory and application of typological analysis') the focus shifts from the empirical to a theoretical level of analysis. The aim here is the clarification of the conceptual framework of the typological approach. Thus, issues concerning the notion of type and its use as a descriptive and prescriptive tool in architecture are dealt with. To this end, the historical and contextual transformations of the notion of type in architectural thought are set out, and brief reference is made to the way the concept has been developed and established as a methodological device in archaeology and biology. Both fields have affected the formation and use of types in architecture. The core theme of this chapter is the distinction between 'type' and 'class' and this provides the theoretical basis of the remaining chapters.

In chapter 5 ('The typology of mills') I have attempted to develop a procedure for typological analysis with the help of the tools derived from chapter 4. Furthermore, I have identified and described the types of mills, and have arranged them according to their geographical and temporal occurrence.

Whereas chapter 5 deals with the description of types, chapter 6 ('The interpretation of mill types') is concerned with their explanation. It shifts description from the formalistic level (identification of types) to the interpretive one. It re-reads the types identified in chapter 5 with a critical eye and offers an explanation of their origins, meaning and relationships. For this purpose it re-introduces material from chapters 1 and 2, and additionally explores the conditions in the architectural profession and education in Greece, and refers to their likely effects on mill design.

Chapter 7 ('A discussion of theoretical issues involved in the typological approach') deals with some important issues concerning the use of types as descriptive tools in architecture, and discusses them in the light of the conclusions of the case-study. Thus, the results of the typological analysis are used in the discussion of issues such as: the relationship between building class and form type, the potential and justification of the use of types in historical description, the conditions of the emergence, evolution, coexistence, succession and death of types and the 'biological fallacy' associated with the notion of type in architecture.

Finally, in a separate section the general conclusions of

thesis are summarized. They refer mainly to the descriptive strength and the limitations of typological approach. Also, they concentrate on what the use of a typological analysis has led to in application to mills.

CHAPTER 1

THE GENERAL BACKGROUND

INTRODUCTION

This chapter contains a description of the overall socio-economic framework within which Greek mill buildings evolved. The aim is to present briefly the particular aspects of the social and economic life in Greece, which had an impact on the development of the manufacturing industry in general and on textiles in particular.

The chapter focuses upon matters related to the economic history of Greece, and especially on the evolution of industry with emphasis on the textile sector. The analysis extends from the industrial revolution to the present. Considering that the industrial revolution was a sequence of qualitative transformations which at certain periods took place at all levels of the socioeconomic life of many countries, and created the necessary conditions for their transition to the capitalist mode of production, it can be said that in Greece these transformations started to occur in the last decades of the nineteenth century and were accomplished by the end of the second decade of the twentieth century. However, the dominance of the capitalist mode of production in Greece did not follow the same pattern as that of the industrialized countries of Western Europe and the United States of America. The particularities of this process are analysed briefly in this chapter.

The chapter contains three sections. These cover the socio-economic factors which influenced industrialization and the structure of Greek industry (section 1.1), the basic economic

and technical characteristics of the manufacturing industry (section 1.2), and finally the particular traits and conditions of the textile sector (section 1.3).

1.1. THE SOCIOECONOMIC CONDITIONS

The slow and contradictory development of capitalism in Greece has been conditioned by certain historical circumstances and domestic particularities. The process of industrialization took place within an already existing economic framework determined by the advanced level of industrial development of the Western part of Europe and the United States.

After the completion of the Greek war of independence from the Ottoman Empire (1830), Greece developed mainly as an agrarian and mercantile society with low capital per head and nearly non-existent industry. The political and economic dependence of the state on the West influenced the economic choices made by Greek governments at the national level.

Before 1880 a number of factors had a restraining influence on the development of industry. These factors can be summarized as follows: the dominant merchant and finance capital (either indigenous, foreign or of diaspora origin) avoided the sphere of production, there was an unstable political situation, there was the lack of skilled labour, the internal market was relatively small and still in its formative years, there was an absence of efficient land transport, and finally the state practiced a non-protectionist policy which stemmed from French liberal economic thought¹.

During the forty years around the turn of the century (1880-1920)² a number of fundamental changes occurred which created the necessary preconditions for the growth of industrial

capitalism after 1920. These transformations were related to the disturbance of the Balkan *status quo* and the changing nature of Western capitalism around the end of the nineteenth century.³

Specifically, Greece with its Balkan neighbours acquired the major part of Macedonia, Southern Epirus and a number of Aegean islands through a collective military action against the Ottoman Empire. This war took place between 1912 and 1913. As a result Greece increased its territory by almost 68% and its population by about 78% (Table 1).

Table 1

Year	Land	Population
1880	50,211 km ²	1,695,160
1881	63,606 km ²	2,004,991*
1883	"	2,049,070
1904	"	2,576,366
1912	"	2,727,275
1914	119,050 km ²	4,867,378**



* Annexation of Thessaly

**Annexation of Macedonia,
Epirus and Crete

Thessaly
Macedonia, Epirus
and Crete

Source: G. HARITAKIS, op. cit., p.37

In parallel a number of changes happened in the Western economy. The western part of the continent witnessed rapid industrialization and by the middle of the nineteenth

century started to compete with the industrially advanced Britain. A highly competitive climate developed and the capital which had accumulated in these countries felt the pressing need for expansion beyond national boundaries. The Balkan area provided an attractive area for investment.

Under those conditions, Greece witnessed a kind of interference which can be characterized as 'structural' as opposed to the 'manipulative'⁴ which was the favourite form of influence of the Great Powers over Greece before the 1880's. Foreign capital inflows to Greece were in the form of government loans and railway investments. The expansion of the railways resulted in the creation, for the first time, of a unified and relatively large internal market.

In the course of the years between 1880 and 1922 the Greek State took a number of major measures with the aim of westernizing Greece, and started to control the economy by intervention. As regards the secondary sector, the repeated devaluation of the national currency (1880-1895), the introduction of protective tariffs on imported products, and the influx of foreign and diaspora capital led to some industrial growth.

The beginning of the 20's was marked by a number of incidents which had fundamental consequences for the future development of Greece. The defeat of the Greek army in Asia Minor by the Turks (1922) defined the final territorial boundaries of Greece and resulted in a massive influx of Greek refugees from Asia Minor to their home country. The number of refugees

was very large (1,500,000) in comparison with the population of Greece (5,000,000) at that period and came to play an important role in the economic life of the country. They made available an exceptionally large quantity of very cheap, and not entirely unskilled labour; 65% of them were small industrialists⁵ who had brought with them not only experience and skills but some of their savings as well. The majority of refugees settled in the big urban centres of Piraeus, Patras and Thessaloniki and became engaged mainly in the textile sector.

During the inter-War period Greece witnessed another massive inflow of foreign capital⁶ in the form of aid for the refugees from the League of Nations, and of government loans for public works, productive purposes and aid to Banks. At the same period the domestic capital started to be invested in the secondary sector.

All these circumstances combined in the first major step forward of the industrial sector in Greece despite the fact that until the beginning of the 60's the contribution of industry to the production of national income was less important than the agricultural sector (the relationship was 10-12% as against 46-48%).

X From the beginning of the '20⁰s onwards industry started to function as a dynamic sector of the Greek economy. The word 'dynamic' is used in the sense of N.Mouzelis where it does not imply "... any high rates of growth, as rather the fact that from this time on, the systematic transfer of resources from the simple commodity mode of production (prevalent in

agriculture and handicraft industry) to the 'modern' capitalist industrial sector became a salient feature of the Greek social formation"⁷.

This picture of increasing prosperity was according to the historian Svoronos "superficial and it only served but a minority, since it was based mainly on foreign capital which was imported massively in the form of loans and controlled the economy of the country"⁸.

This development was restrained by the world economic crisis of 1929-31 and later was abruptly stopped by the Second World War. The political events that followed the end of World War Two, the tragic end of the civil war (1946-1949), and the new conditions in the international scene, determined the economic and social life of Greece.

The main task of the post-civil war Greek governments was to achieve the reconstruction of the country and its future development in parallel with their political survival. To achieve these aims, during the immediate years after the War, they relied on foreign patrons, such as Britain and mainly on the United States of America. The 'Truman Doctrine' and its economic expression in the 'Marshall Plan' was the framework within which the Greek government was called on to find the future economic development of Greece. As regards the policy of the post War development there were two major trends⁹. The first promoted the model of a free market economy dominated by the principles of *laissez faire*, where priority should be given to agriculture and manufacturing industries which were not capital intensive, whereas the second proclaimed the model of active state intervention with its main priority being the development of heavy industry.

In the end it was the first that prevailed and from then on the country's economy was based on the decisive role of foreign capital.

After the War the Greek state gradually started to intervene in the economy to strengthen the market forces. That intervention was manifested in a number of measures which provided protection to small enterprises and did not operate as a deliberate device to foster industrialization and economic growth. Government intervention took the form of 'expedience' licences, incentives of fiscal character, geographic decentralization and attraction of foreign capital.

The first systematic legal measure taken to attract private foreign investment was the Legislative Decree 2687/1953¹⁰. This statutory arrangement resulted in the rapid inflow of foreign capital into the Greek economy. It was the first time that foreign entrepreneurs showed significant interest in investing in manufacturing industry and were directed towards important branches where Greek capital was unwilling or unable to go. Greek private capital at the beginning of the 50's was orientated towards tourism, shipping, the construction industry and the traditional sector of textiles, food etc. The reasons for their preferences were related to the general state policy and to some characteristics of the indigenous entrepreneurship such as the desire for quick and easy profit, absence of risktaking, the family basis of the organization of firms etc¹¹.

By the early years of the 60's the financial contribution of the industrial sector in GNP exceeded for the first time

that of the agricultural sector. The source of this advancement was more exogenous rather than endogenous since it was based mostly on foreign capital. Thus, Greece followed a different path for its industrialization from that of the West, and did not "eradicate the major features of underdevelopment which had characterised the 1922-60 period".¹²

There is a vast bibliography on the post-60's development of the Greek economy written from various points of view. However, the majority of these publications conclude that the Greek economic development and industrialization exhibits the major characteristics of dependence. These are exemplified as: industrialization based on the external market, on foreign capital, on technology which is not indigenous, and on the lack of a comprehensive industrial base¹³ (low value added and absence of dynamic 'key' sectors in the economy).

During the last twenty years the foreign capital that entered the Greek economy was invested in 'key' sectors such as in industries of metal manufacturing and of chemical and petroleum products which were mainly orientated towards the external market. At the same time the traditional branches remained mainly under Greek control and were orientated to the internal market. For instance, the foreign control in the industrial sector in 1972 was 29.8% whereas in textiles it was only 4.3% (the smallest after printing), and in petroleum products 95.0%. A shift occurred after the crisis of the beginning of the 70's which was the result of the international economic crisis and the political

situation of Greece. The exports of key sectors diminished, the foreign capital inflows decreased and started being orientated towards the production of consumer goods for the internal market. In parallel, traditional branches turned towards the external markets.

In the year 1974, when the fall of the junta occurred, a new period of state intervention opened not only in the economy but also in other levels of social life. However, after the crisis of 1973 a gradual devaluation of the position of the country and a return to old traditional structures occurred in the international division of labour.

1.2. THE BASIC CHARACTERISTICS OF THE MANUFACTURING INDUSTRY

This section describes briefly the evolution of the basic economic and technical characteristics of Greek manufacturing industry from the end of nineteenth century to the present. More analytically, it explores the major changes which occurred in the number and size of manufacturing units, the average annual employment, the degree of mechanization in producing units, the locational pattern and the synthesis of the Gross National Product (GNP).

The industrial sector occupied a strikingly limited position in the Greek economy from the turn of the century to the 20's both in output, in employment and in capital investment. The number of factories established during the period 1867-1920 is extremely low as illustrated in table 2. The majority of these were small family businesses and were not based on

Table 2: NUMBER OF ESTABLISHMENTS, THEIR MACHINES AND INSTALLED MECHANICAL POWER, 1867, 1875, 1889, 1900, 1917, 1920

Year	Number of establishments	Establishments using machines	Installed Mechanical Power (H.P.)
1867	168	22	296
1875	199	95	1,967
1889	--	145	5,568
1900	421	--	--
1917	2,213	1,870	7,000
1920	13,335	7,887	110,673

Source: A combination of information from S. LOVERDOS, 'The National Wealth', (in Greek), Athens 1902, p.p. 3-45, and NATIONAL STATISTICAL SERVICE OF GREECE, 'The Statistical Yearbook of Greece', Year 1930, p. 12.

wage labour but were closer to an artisan type of economic activity. Nevertheless, there was a limited number of corporations in comparison to the total number of firms. According to X. Zolotas 12 corporations existed in 1896 which by 1904 had increased to 20, to 50 in 1918, and to 130 in 1924¹⁴. The rapid centralization of Greek capital after 1918 was conditioned by the fact that a law assisting the establishment of corporations was passed in 1912. However, the basic characteristic of Greek industry was the extraordinarily small size of the industrial plants.

The rapid increase of the number of factories after 1910 shows the first signs of industrial progress. This was noted as early as 1923 by R.F.H. Duke. He wrote in his report,

"Greece is not primarily an industrial country and her manufactures have not reached a high pitch of development. There are signs that industry is developing and some of the prominent Greek businessmen who have hitherto been engaged purely in mercantile operations are investing capital in industrial companies and creating groups for the establishment of new and modernization of old factories"¹⁵.

Thus from 1920 to 1938, despite the international crisis of 1929-1930 which affected the Greek economy, the value of industrial production increased from 1,077 (in million 'stabilized' drachmas) to 13,552, the number of factories from 13,335 to 44,868, the employed labour force from 124,013 to 184,544 and the total horse power from 72,841 to 99,542¹⁶. This progress was abruptly stopped by World War Two.

The second half of the 40's decade was mainly a period of reconstruction. After 1950 the number of manufacturing establishments started to increase gradually, as can be seen in table 3, apart from a drop of 0,8% which occurred during

Table 3: NUMBER OF ESTABLISHMENTS AND NUMBER OF PERSONS ENGAGED THEREIN, IN 1951, 58, 63, 69, 73, 78

Year	Number of Establishments	Average Annual Employment
1951	81,417	269,169
1958	109,236	413,639
1963	122,332	471,564
1969	124,651	501,565
1973	121,357	604,042
1978	128,988	671,496

Sources: Extracted from NATIONAL STATISTICAL SERVICE OF GREECE 'The Statistical Yearbook of Greece', of 1968, 1974, 1981 and 'The Statistical Summary of Greece', 1954

the period 1969-1973. In contrast the average annual employment for the same period increased by 28,1% implying a dramatic change in the average size of the firms.

However, one of the major characteristics of the post-War development of the manufacturing sector is the extremely large number of small scale units in terms of employed persons. Table 4 shows the extraordinary fragmentation of Greek industry, where around 93% of the firms employ less than 9 persons. The mild increase in the size of firms during the

Table 4: SIZE DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS,
1930, 1958, 1963, 1973, 1978

Size group (persons employed)	% of the total number of establishments	% of the total employment
A. 1930 Census		
up to 5	93.3	43,2
6 - 25	6.4	17,8
25 and over	1.3	39,0
B. 1958 Census		
up to 5	94.7	36,3
6 - 20	4.6	25,4
21 and over	0.7	38,2
C. 1963 Census		
up to 9	95	47.5
10 - 29	3.5	14.9
30 and over	1.5	37.6
D. 1973 Census		
up to 9	93	49
10 - 29	4.7	14.1
30 and over	2.3	36.9

con

E. 1978 Census			
up to 9	93		44.5
10 - 29	4.6		15.1
30 and over	2.4		40.4

Sources: Extracted from NATIONAL STATISTICAL SERVICE OF GREECE, 'The Statistical Yearbook of Greece', 1968, '1976, 1978, 1982, 'The Census of Industrial, Handicraft and Commercial Establishments', 1958

last five decades was accompanied by capital centralization in a few firms. This can be clearly assumed as well, by the fact that 94 per cent of corporations in 1959 and 97 per cent in 1980 held only 46.5 per cent and 37 per cent of total assets respectively, whereas only 6 per cent of corporations owned 53.5 per cent of total assets in 1958, and only 3 per cent of corporations in 1980 owned 63 per cent of the total assets.

An important change occurred after 1950 concerning the contribution of the major sectors of the economy to the formation of the Gross Domestic Product. Table 5 shows the increasing dynamism of the industrial sector, especially after 1960.

Table 5: CONTRIBUTION OF THE MAJOR ECONOMIC SECTORS TO THE FORMATION OF G.D.P.

In constant prices of 1958

Sector	1938	1951	1960	1970	1974
Agriculture, Mining	34.3	30.0	24.4	18.4	16.9
Manufacturing	18.6	19.0	26.0	33.2	35.5
Commerce, Services etc.	47.1	51.0	51.0	48.4	47.6
Total:	100.0	100.0	100.0	100.0	100.0

Source: S. BABANASIS, K. SOULAS, 'Greece in the Periphery of the Developed Countries', (in Greek), Ed. Themelio, Athens, 1976, p. 43.

The process of concentration of industrial production and labour force in a limited number of manufacturing firms is accompanied by an increase in their fixed assets. A large part of the fixed assets is orientated towards the purchase of new machinery or improvement of the old. However the majority of firms, and particularly the small, have antiquated equipment with consequences on their competitive ability within the Greek market and the international one as well.

The lack of mechanization in Greek producing units is illustrated in table 6 which shows the change in the percentage of units with installed mechanical power during the last two decades, and also the installed capacity per establishment.

Table 6: ESTABLISHMENTS POSSESSING MECHANICAL POWER AND INSTALLED CAPACITY PER ESTABLISHMENT, YEARS 1958, 1963, 1973, 1978

Year	Number of Establishments	Establishments with motors	Establishments with motors (% of the total number)	HP/Establishment
1958	109,236	33,972	31.1%	22.8
1963	122,332	50,450	41%	22.93
1973	121,357	84,237	69.4%	44.75
1978	128,988	86,697	67.2%	52.13

Sources: Extracted from NATIONAL STATISTICAL SERVICE OF GREECE

'The Statistical Yearbook of Greece, 1968, 1982 and G. COUTSOUMARIS, 'The Morphology of Greek Industry' Centre of Economic Research, Athens, 1963, p.54, and T.TASSOPOULOS, 'Greek Industry', (in Greek), ed. Timfi, Athens 1978, p. 95

The kind of motive power which is used in factories has changed gradually from water and steam to petrol and electricity.

The first factories at the end of the nineteenth century relied on water or steam power. According to Demathas¹⁷ in 1876 there were 150 steam powered factories and 700 water powered ones, within the boundaries of Greece of that period. However this information is rather inadequate and due to the lack of statistical data we can hardly argue about the degree of use of water and steam power in the shaft drive systems. It was only after the second decade of the century that electric motors started to replace water and steam gear.

In the already industrialized countries in Europe and the United States this shift had already occurred by the middle of the 1880's after M. Faraday's discovery of the principle of the electric motor in 1821 and Crompton's development of electric power for industrial use in the 1870's¹⁸.

In Greece, in 1929, the newly established firms used petrol power (60%), electric power (30%) and steam power (10%)¹⁹. According to a report of the Ministry of National Economy, published in the magazine 'Erga', there appears to have been a considerable shift to electric power after 1930 when all

the large factories in the area of Athens converted to electric power which was provided by a recently established factory in Piraeus²⁰. From then on the use of electricity in industry increased rapidly as can be seen in table 7.

Table 7: TOTAL ELECTRIC H.P. AS % OF THE TOTAL INSTALLED MECHANICAL POWER

	1920	1930	1958	1963	1969	1973	1978
Electric H.P. as % of the total installed m.p.	10%	28.1%	68.7%	84.3%	93.6%	97.1%	97.3%

Sources: Extracted from G.COUTSOUMARIS, op.cit., p. 57 and NATIONAL STATISTICAL SERVICE OF GREECE, 'The Census of Industrial, Handicraft and Commercial Establishments', 1920, 1930, 1958, 1963, 1969, 1973, 1978

As regards the locational pattern of Greek industry a major shift occurred from its relatively even geographical distribution at the beginning of the century, to its rather disproportionate concentration in the region of Athens after the War.

After the turn of the century the Greek territory appeared to have a balanced industrial development with Athens growing gradually in population and a number of urban centres such as Thessaloniki, Patras, Volos, Larisa, Corfu, Heraklion, Hania etc. (fig. 1) which constituted nuclei of economic and social life.

The rapid industrialization after the 20's was accompanied by a heavy concentration of industry in the Athens metropolitan

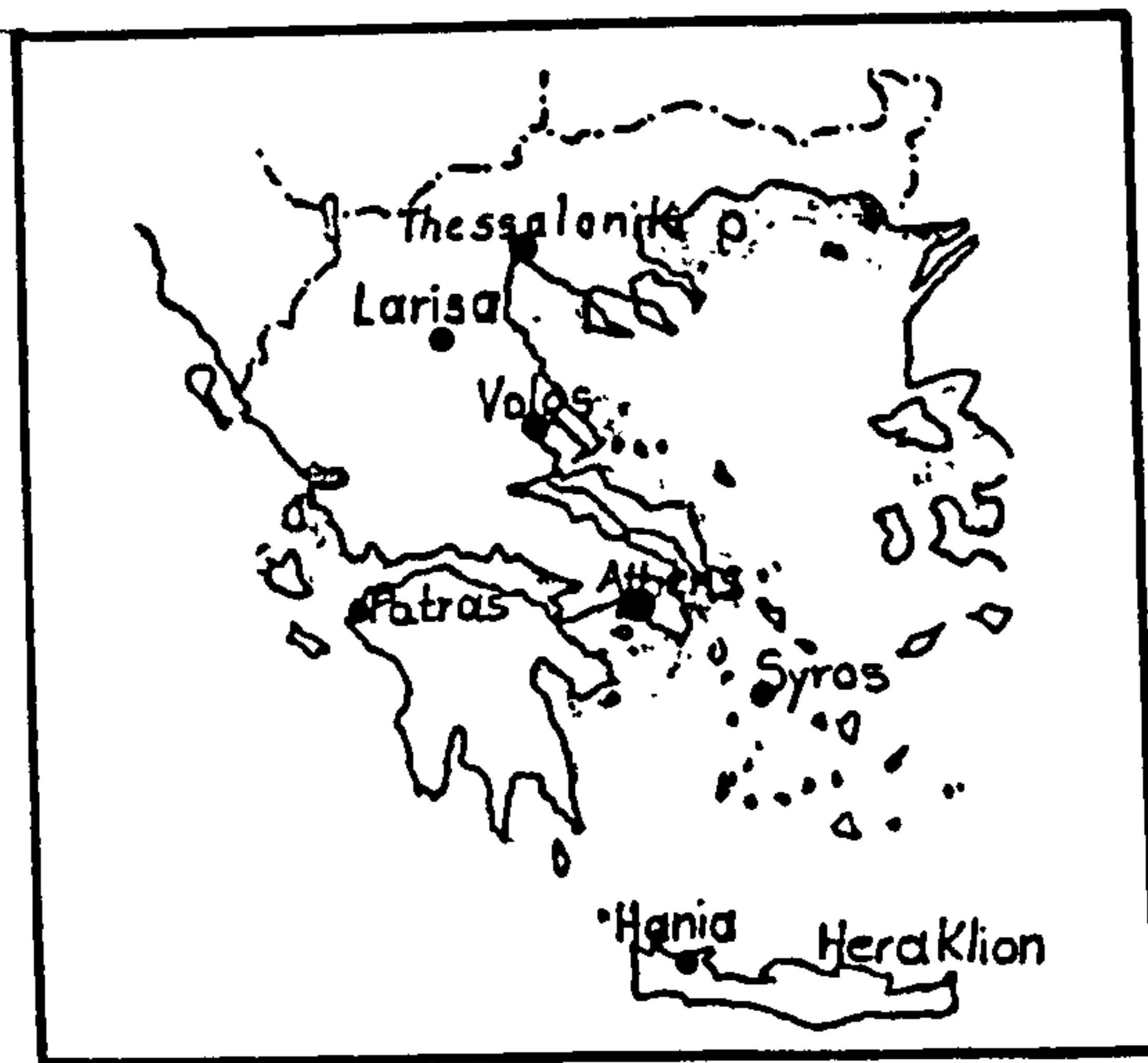


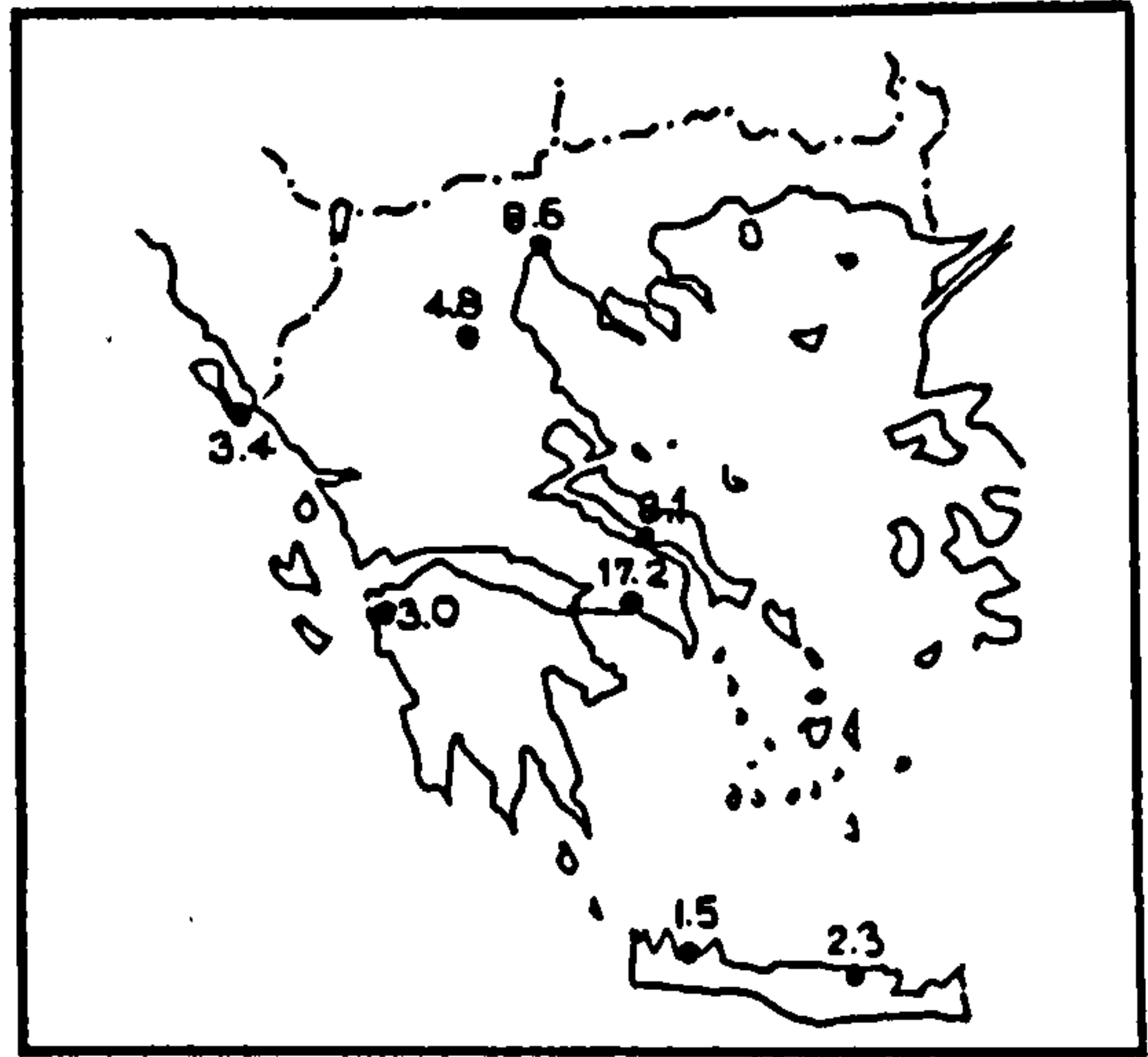
Fig. 1. Location of major urban centres in Greece

area. In parallel, the other urban centres withered (fig.2) in relative terms. The locational pattern of the Greek manufacturing industry, which was consolidated after the War, was consistent with the operating economic forces. As G. Coutsoumaris stressed in 1964 "the concentration of manufacturing firms in the greater Athens area is nothing but the natural outcome of past conditions and expectations which have led the individual firms to search for the 'optimum' location of their plants. The minor exceptions can be attributed to non-economic considerations"²¹.

The Greek post-War governments embarked upon a policy of promoting the establishment of industrial firms in regions away from Athens²². In the period 1948-62 a number of statutory measures were passed with the aim of supporting regional industry. After 1962 these measures, mainly fiscal in character, were increased and reinforced with the parallel establishment of industrial zones in various parts of the country. Finally, after 1974, the measures for industrial decentralization were incorporated within a general attempt to encourage regional development. However, the policy of reinforcing industrial reallocation did not have the expected results since the system of incentives which was prescribed was rather perplexing and difficult to interpret and apply.



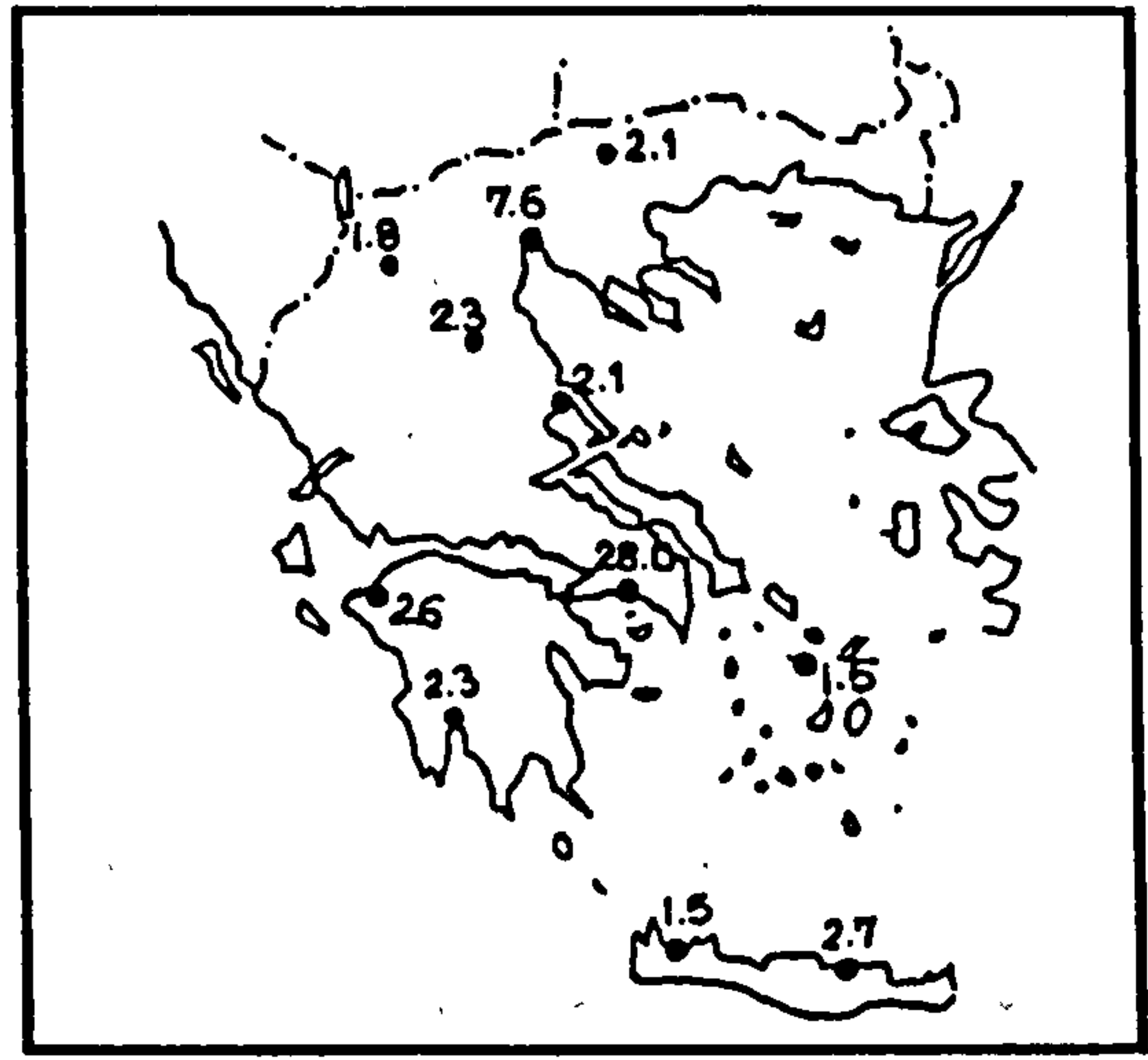
1920



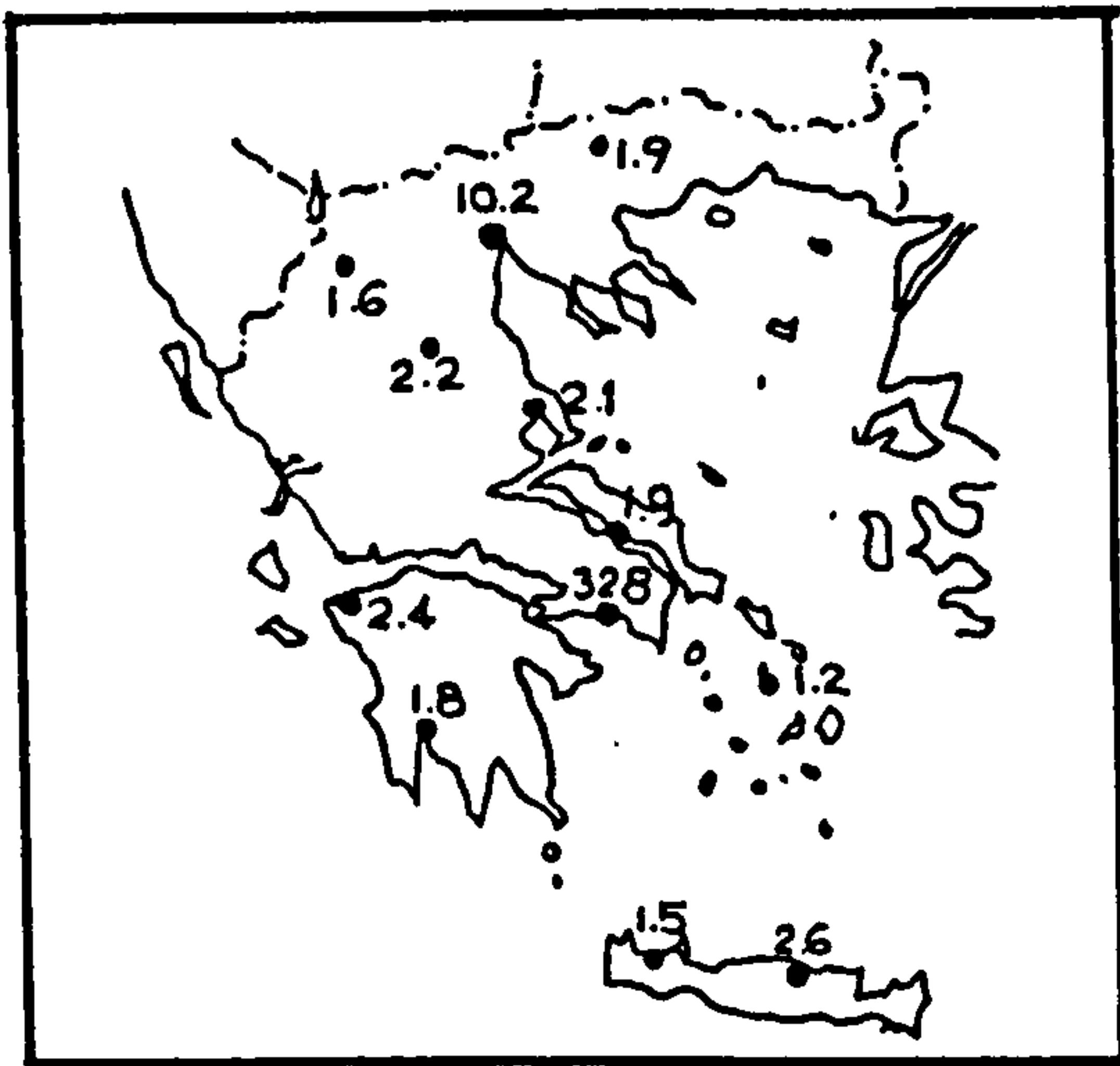
1930



1958



1963



1969



1978

Fig. 2. The percentage distribution of all manufacturing units in major regions of Greece for the years 1920, 1930, 1958, 1963, 1969 and 1978

Source: Extraced from NATIONAL STATISTICAL SERVICE OF GREECE, 'Census of Industrial and Commercial Establishments', 1920, 1930 and 'The Statistical Yearbook of Greece', 1969, 1980

Although during the last decade a number of urban centres - Thessaloniki, Volos, Patras - have shown increasing dynamism and many new and large firms have been established in the frontier regions of Thraki and Dodekanisa, since they were favoured by a number of laws passed after 1976, the general picture of the country shows the dominant role of Athens in terms of industrial concentration.

1.3. THE MORPHOLOGY AND CHARACTERISTICS OF THE TEXTILE SECTOR

One of the major characteristics of textiles is the variety of raw materials, and the extraordinary wide range of products. The raw materials are the traditional ones of cotton, wool, silk, jute and flax, and also the synthetic fibres which have been developed mainly after the Second World War. The basic categories of products are: yarns, fabrics, household textiles (sheets, towels, napkins, blankets, table-cloths), furnishing textiles, carpets and textile products for industrial use (canvas, nets, paddings, belts etc).

The focus of this work is on manufacturing industries whose products are yarns or/and fabrics made from cotton, wool and man-made fibres. The reasons for this particular choice are related to the fact that the most important branches of Greek textiles are spinning and weaving of cotton, wool and synthetics. The economic features of this section are true on the whole of all Greek textiles²³.

The contribution of the textile sector to the basic indices

of manufacturing industry (Average Annual Employment, contribution to the formation of Gross National Product, Value of Industrial Production, and Surplus Value) was and is very important, since it always ranked third or second among the other sectors of manufacturing after foodstuffs and clothing. Furthermore the production index of the sector was always very close to the general industrial production index and after the mid 70's it exceeded it. However, the general situation changed from 1980 onwards when the production index started to fall due to changes in the international market which affected Greek textiles after the entry of Greece in the E.E.C.

The textile industry from the end of the nineteenth century showed a dynamism which later on grew in importance with the influx of refugees from Asia Minor. As E.G.Mears described in his book 'Greece Today. The Aftermath of the Refugee

Impact', "the large number of refugees who were willing to work cheaply in order to live has promoted the prosperity of textile mills already established. Manufacturers of cotton and wool yarn and fabrics, of jute cloth for sacking, and of silk thread and cloth took advantage of the new labour supply to build up their lines of business. One small silk factory which was located outside Athens, close to the refugee settlement, Ionia, has grown from the very small establishment it was a few years ago to a large factory covering several thousand square yards and employing 2,400 people."²⁴. However, the majority of refugees was orientated

towards the rug production sector (fig. 3,4) which between 1923 and 1929 increased rapidly in terms of number of factories, employment and value of production.

The growing importance of textiles after 1920 with respect to the number of manufacturing units and the average annual



Fig. 3. Weavers on their benches in a large rugplant ²⁵



Fig. 4. Hand-trimming rugs before packing for shipment ²⁶

employment is illustrated in table 8. One can see an annual compound rate of growth between 1920 and 1978 in the number of firms of 3.5% and in employment of 3.4%.

Table 8: NUMBER OF ESTABLISHMENTS AND AVERAGE ANNUAL EMPLOYMENT

	1920	1930	1951	1958	1963	1969	1973	1978
Number of Establish.	704	1,018	2,291	3,570	4,465	5,109	5,076	5,049
Average annual employment	10,961	22,298	64,205	53,346	55,916	54,961	68,419	78,377

Sources: Extracted from NATIONAL STATISTICAL SERVICE OF GREECE, 'The Statistical Yearbook of Greece', 1930, 1937, 1965, 1970, 1974, 1981 and 'The Statistical Summary of Greece', 1954.

The diminution of the number of firms during the last ten years was accompanied by increasing trends in concentration since 19% of the firms employ 80% of the workers. At the same time the majority of large firms renewed their antiquated machines and techniques. The characteristic of the sector until the beginning of the 70's was the use of old methods and machinery. H.S. Ellis *et al* in their study on 'Industrial Capital in Greek Development', pointed out that "in textiles expansion of output was hampered by old machinery; in 1958, only half of the equipment was characterized as modern"²⁷, and in another chapter they claimed, referring to the mid 60's, that "complaints of antiquated equipment - not generally throughout the industry but particularly in smaller firms - are to be found, for example in cotton and wool textiles"²⁸.

From the beginning of the 70's onwards most of the firms - both old and new - introduced modern methods of production based on imported modern machines. This fact is not mirrored in all branches of the textile sector but mostly in the cotton spinning and weaving industries.

Table 9 illustrates the gradual introduction of mechanical power and electricity from 1920 to 1978.

Table 9: ESTABLISHMENTS POSSESSING MECHANICAL POWER,
INSTALLED CAPACITY PER ESTABLISHMENT AND TOTAL
ELECTRIC H.P.

	1920	1930	1958	1963	1973	1978
Establishments with power as % of Total Number of Establishments	20.0	34.3	65.5	67.8	75.7	80.0
Installed Capacity per Establishment in HP	13.9	22.9	29.6	38.8	65.5	123.2
Total Electric HP as % of Total Installed Mech.Power	5.0	31.8	76.5	95.7	97.1	97.3

Sources: Extracted from NATIONAL STATISTICAL SERVICE OF
GREECE, 'The Census of Industrial, Handicraft and
Commercial Establishments', 1920, 1930, 1958, 1963,
1973, 1979.

The geographical allocation of textile firms shows some differences from the allocation of the total of industrial activity. Textiles, as all light consumer goods industries,

tend to be more evenly distributed among the various regions of the country. According to G. Kafkalas²⁹ textiles have a very low degree of regional concentration, as can also be clearly deduced from fig. 5.

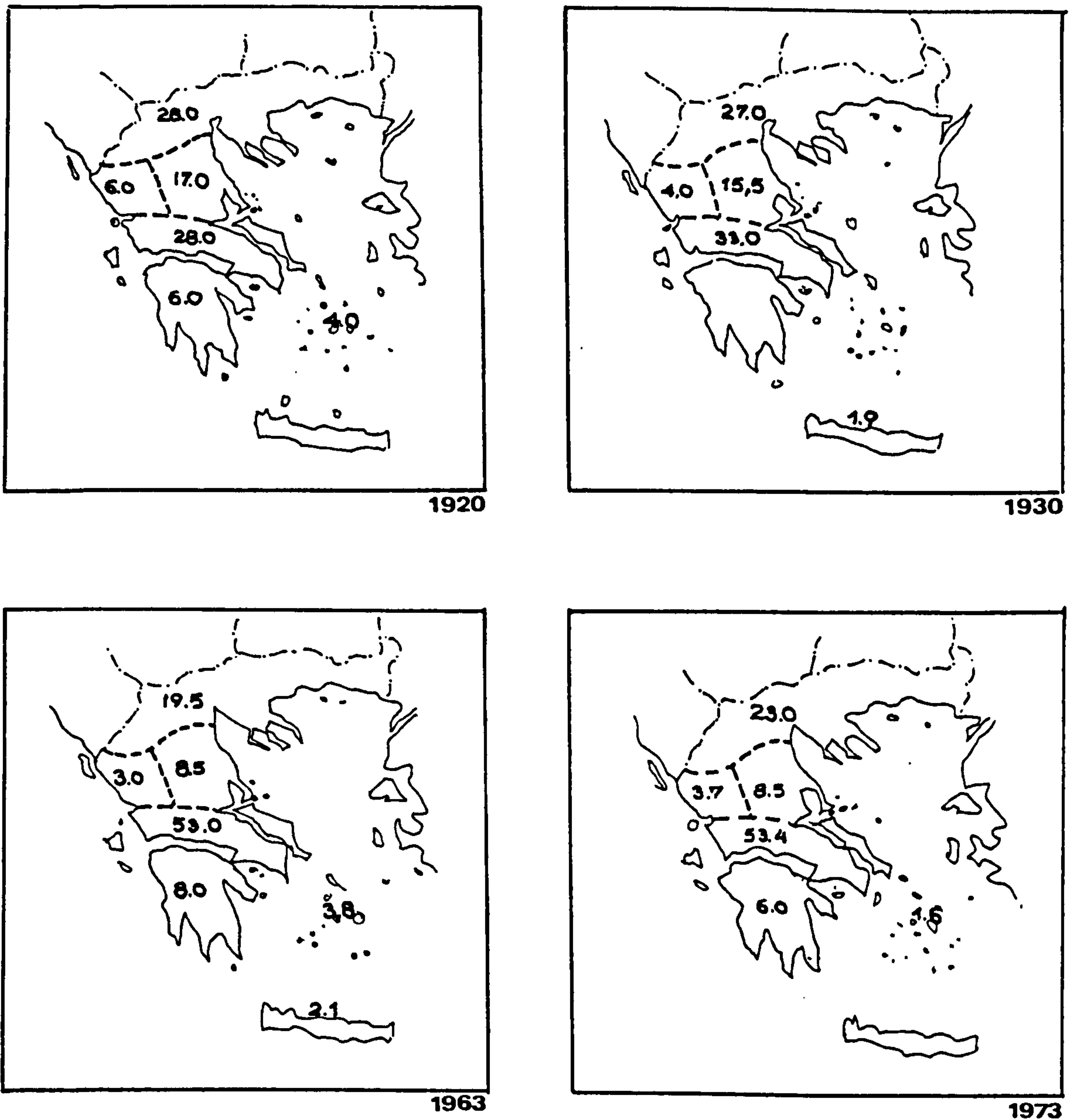


Fig. 5. The percentage distribution of textile mills in major regions of Greece, 1920, 1930, 1963, 1973

Source: Extracted from NATIONAL STATISTICAL SERVICE OF GREECE, 'Census of Industrial and Commercial Establishments', 1920, 1930 and 'The Statistical Yearbook of Greece', 1969, 1980.

There were five main textile industrial centres which flourished during the first years of industrialization and until the War (fig. 6). In Greek Macedonia, the two adjacent cities of Naoussa and Edessa and the city of Thessaloniki were important centres. Textiles developed in Edessa and Naoussa because of the waterfalls of the area, which provided the necessary power for machines. An additional reason was the existence of a skilled labour force due to the traditional employment of the people in small cottage textile industries since the eighteenth century.

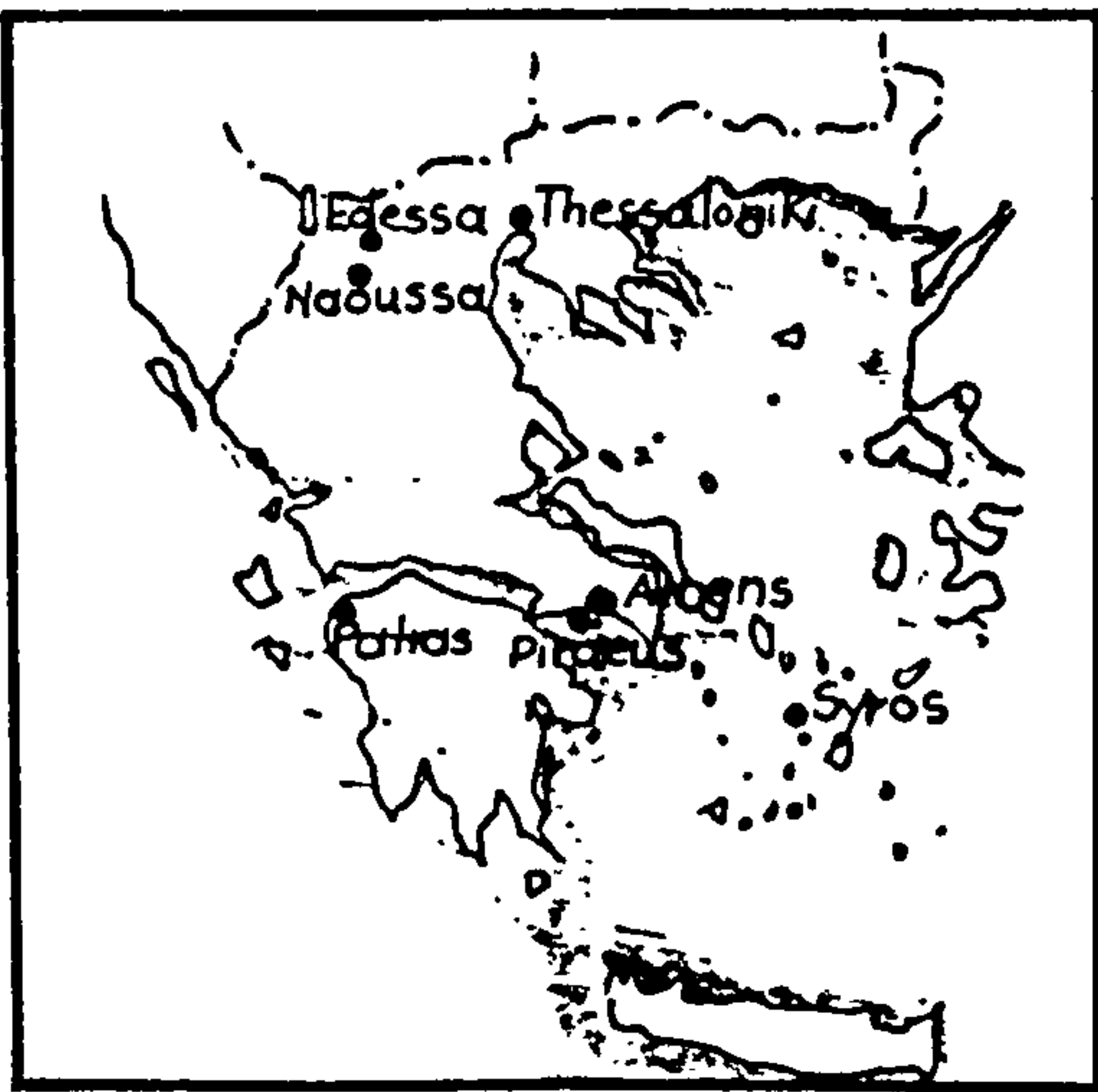


Fig. 6. Textile industrial areas in Greece

Thessaloniki was the other important commercial centre and harbour of the Southern Balkan area. At the beginning of the century the most dynamic sector in the economy of the city was the tobacco industry. After the massive inflow of Greek refugees from Asia Minor, which followed the defeat of the Greek army in 1922, Thessaloniki was one of the centres which attracted large parts of this new population. Active industrialists with adequate capital established dynamic textile industries in the town, or bought old firms which belonged to Turks.

The third industrial centre was represented by the adjacent cities of Piraeus and Athens, and the town of Lavrio in the region of Attica . After 1912 Piraeus became the most important port of entry between Europe and the Middle East, and developed rapidly to become the biggest industrial city of Greece. At the same period the western suburbs of Athens attracted the majority of the incoming refugees who were to constitute the major part of the labour force of new firms in this area. The small town of Lavrio, an important centre of the mining industry from ancient times, became a substantial textile centre after 1922.

The fourth centre was the city of Patras, the second most important Greek harbour. Finally the island of Syros was another big industrial centre, the oldest of all, with activities - mainly shipbuilding - extending back to the early nineteenth century.

For nearly two decades, after the Second World War, the only notable industrial textile area was that of Athens and Piraeus. Later on, after the beginning of the 60's, a decentralization occurred of textile activity to other urban centres due to measures that were taken to stimulate the revitalization of depressed areas of the country suffering from emigration problems.

The analysis which has been given of the characteristics of textile manufacturing does not correspond to all the particular features of every branch of the sector. For instance woolen mills are small in size in terms of employment, output and

mechanized equipment; 60% of the firms use machines which are more than 10 years old³⁰. Concerning their geographical allocation there is a concentration of more than 50% in the area of Athens not only due to the existence of a large market, better infrastructure, available labour force and existence of auxiliary facilities (dying , finishing firms etc), but also due to the fact that the raw material - wool - always was and still is imported from abroad.

On the contrary, cotton mills, which represent nearly 50% of the production of the sector, are more developed than woolen mills and are highly competitive in the international market. The majority consists of middle and large scale units which have recently up-dated their equipment.

Their raw material - cotton - comes exclusively from the internal market. Although during the first decades of the century most of the cotton was imported, in 1954 only 5% of the industrially used cotton came from abroad and the other 95% was produced in Greece³¹. The regional distribution of cotton mills is the most well balanced of all branches. Only 34% of cotton factories are concentrated in the area of Athens and the rest are evenly distributed in the industrial centres of Greece.

The silk manufacturing industry witnessed rapid development with the inflow of refugees at the beginning of the 20's. Its dynamism was curbed after the War with the production of synthetic silk, nylon etc. Today there are only a few silk mills (10 in 1975 and 12 in 1980)³² with low average annual employment and low production index.

The production of synthetic and man-made fibres was introduced in Greece at the end of the 70's. The manufacturing units are very few and are located in the region of Athens. In contrast, there are many modern mills which use synthetic and man-made yarns, imported from abroad, for the production of fabrics and household textiles.



CHAPTER 2

THE NATURE OF MILLS AND IMMEDIATE INFLUENCES ON THEIR DESIGN

INTRODUCTION

This chapter describes four factors which had and still have a specific effect on mill design: the production process, the environmental conditions in the factory, the statutory framework of industry and the availability of building materials.

These factors are not the only ones which influence mill design, but they are the only ones which are extrinsic to designers and to industrial clients. Thus, they have an objective character, they are not a simple picture-frame within which mill design takes place, but play a determining role in design. Furthermore, they are not related to specific buildings, but on the contrary refer to all textile buildings.

The chapter sets out diachronically a general analysis of every factor with parallel references to Greek reality.

2.1. BASIC STAGES OF THE PRODUCTION PROCESS - THE MACHINERY

The textile industry uses a variety of raw materials (fibres) with different physical properties and origins¹. The most important distinction of fibres is between natural and man-made. Natural fibre is any flexible substance (of animal, vegetable or mineral origin) having such as silk, wool, cotton, flax, jute, asbestos etc. a thread-like form. Man-made fibres are divided into two categories: synthetic fibres and artificial fibres. In synthetic fibres the fibre-forming material is derived from petrochemicals or coal chemicals. Basic classes of synthetic fibres are polyamides (the most important of this class are the nylons), polyesters, polyvinyl derivatives, polyurethane and polypropylenes. In artificial fibres the fibre-forming materials are of natural origin, like viscose rayon (artificial silk) which is made from cellulose obtained from cotton linters or wood pulp. In other words artificial fibres have natural origin but, are not found as the natural fibres in the natural state. Man-made fibres are produced in continuous lengths - filaments - like natural silk. In contrast, the majority of natural fibres exists in nature in short staples (wherefrom their definition as staple fibres).

The distinction between filaments and staple fibres is important since their process into yarn is based on different fundamental principles. Often man-made fibres are cut up into short lengths in order to be processed on ordinary cotton or woollen spinning machinery. This usually happens in Greek textile firms which produce a variety of

yarns made of wool, cotton and synthetic fibres in the same factory.

Thus, this section refers mainly to the production process of spinning staple fibres and weaving the produced yarns. Differences in staple fibres have influenced the design of spinning machines. However, the fundamental principles of yarn processing are the same for all staple fibres². The weaving process is more or less the same since it is not affected by the different physical properties of the various types of yarns.

According to B.C.Goswami *et al* "irrespective of differences in machinery used for different fibres, there are some operations which are fundamental"³:

1. opening, cleaning and mixing
2. sliver formation
3. attenuation of the sliver
4. twist insertion to prevent fibre slip-
page in rovings and yarn
5. packaging of the yarn

In the weaving process⁴ the operations are:

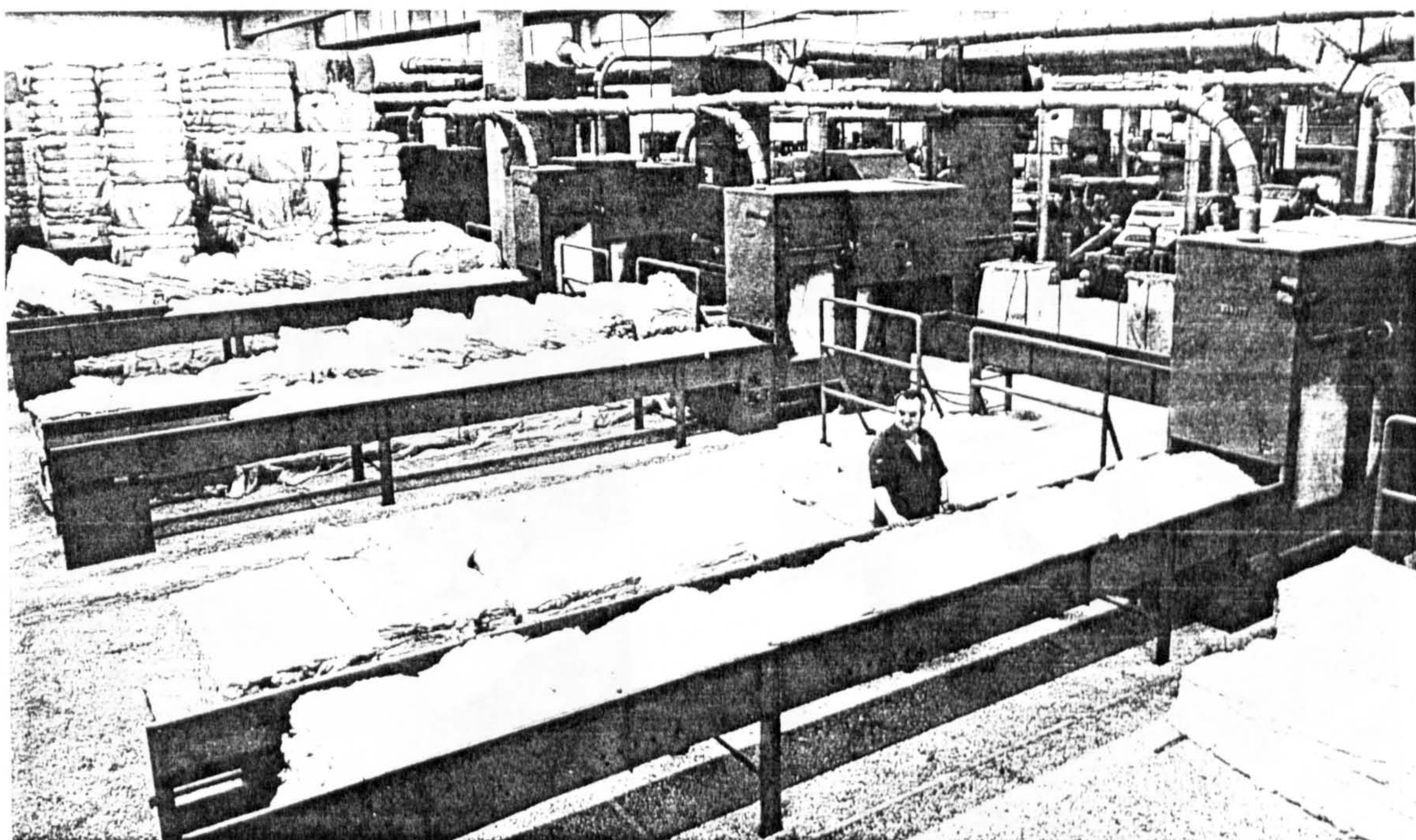
1. warp preparation
2. weft-winding
3. weaving
4. finishing
5. packaging of the fabric

A vertically integrated firm includes nearly all these stages and sometimes also the dying process either of yarn or fabric. The first three processes, i.e. opening, cleaning

and mixing are fundamental. The raw material is received pressed packed and contains impurities which differ according to the origin of the fibres (animal, vegetable or mineral). In addition, the fibres need to be blended because the raw material must have, at the beginning of the process, uniformity concerning the appearance and the appropriate tensile properties. The mixed and cleaned fibres are opened by the combined action of revolving beaters and air currents. The first three stages are inseparable and they take place on the same machine (fig. 7).

Sliver formation takes place on a carding machine (fig. 8). This machine is designed to make the fibres parallel to each other. Apart from this function it removes very short and thin fibres and completes the extraction of remaining impurities. Thus, bunches of fibres are entered into gill boxes so that the fibres fall into a line, as far as possible. The continuity of the feed is maintained and after the gilling operation they come out as a continuous sliver (fig. 9). When the production of a high quality yarn is desired the sliver is processed on a combing machine (fig. 10 and fig. 11). The fibres, up to a selected length, are removed from the sliver in combing machines. The result is a fine yarn.

Sliver usually has more fibres in cross section than those required. Therefore sliver attenuation is necessary and this is achieved through the drafting rollers (fig. 12). Simultaneously the parallelization of fibres is attained. The attenuated sliver has lost some of its cohesion and



*Fig. 7. Opening, cleaning and mixing machines*⁵

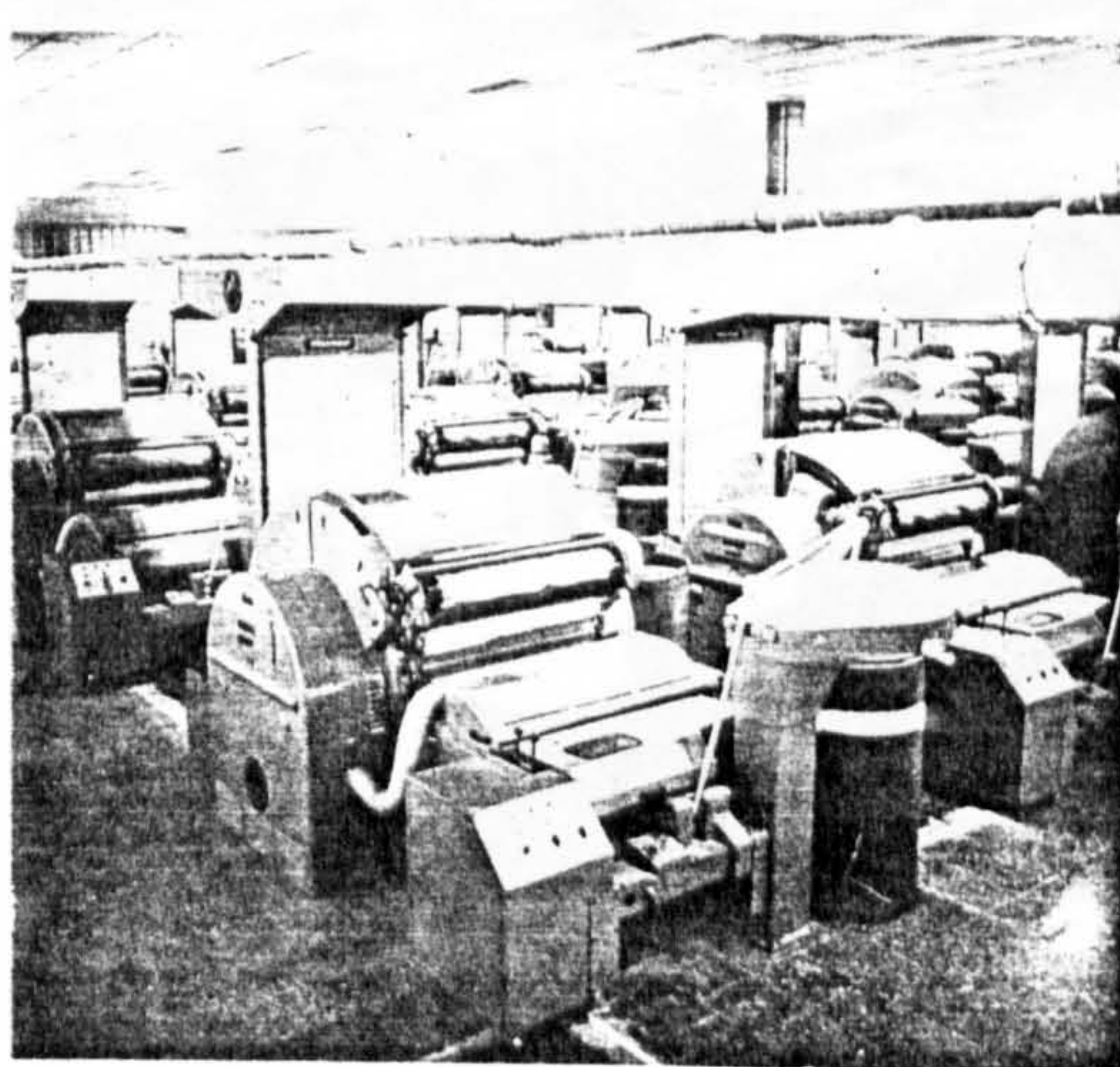


Fig. 8. Carding machines

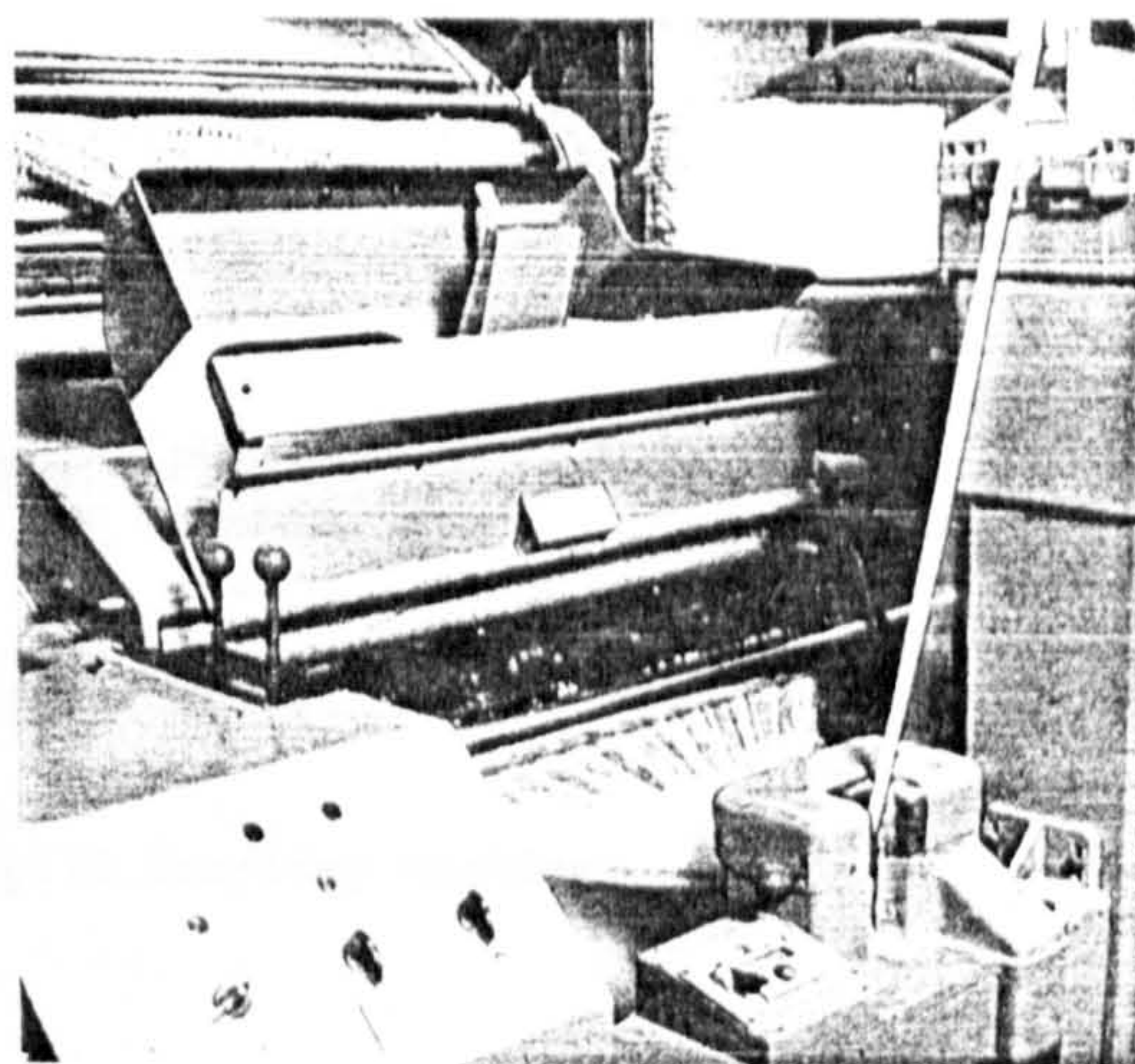


Fig. 9. Detail of the interior of carding machine showing the formation of sliver

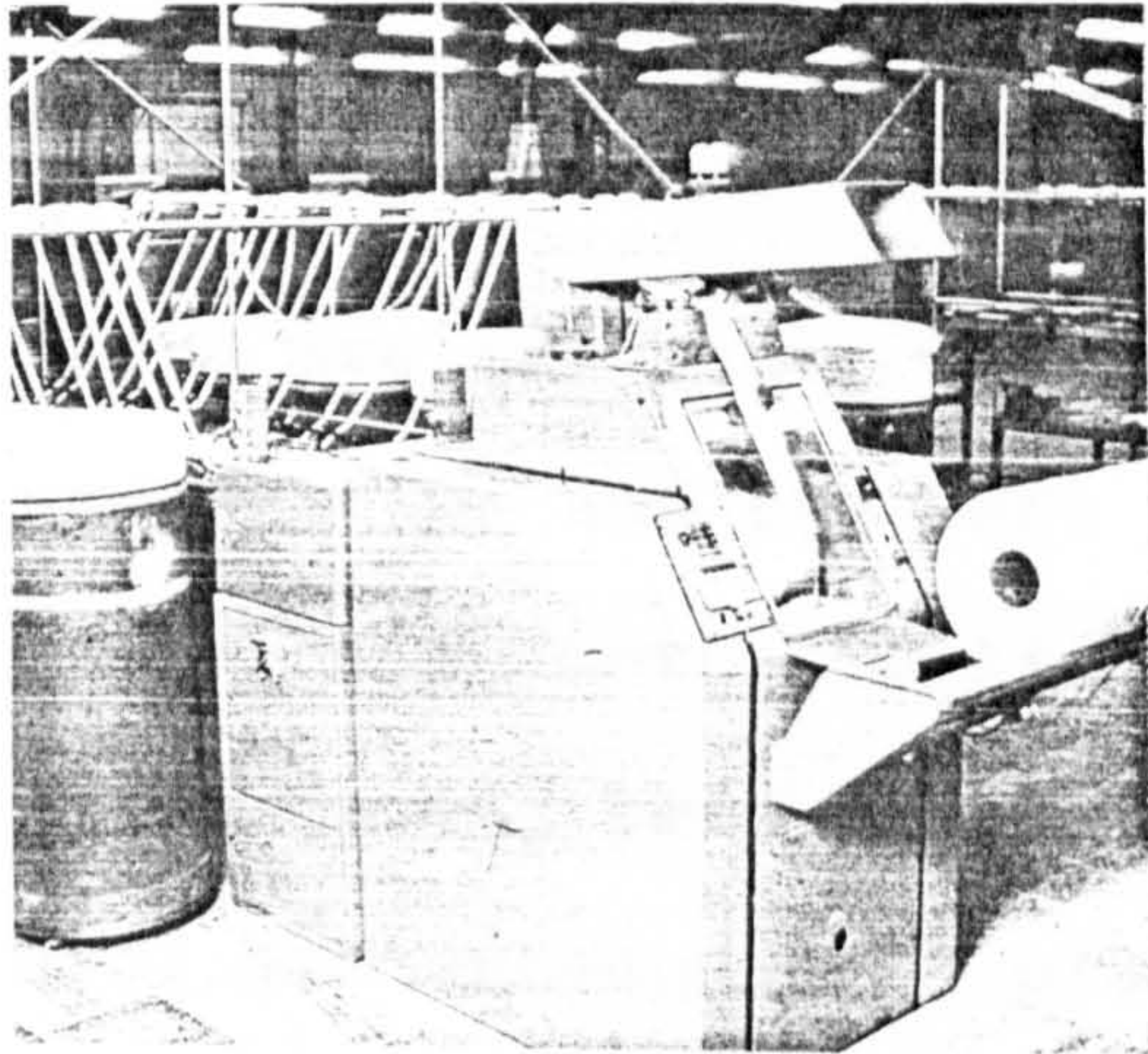


Fig.10.

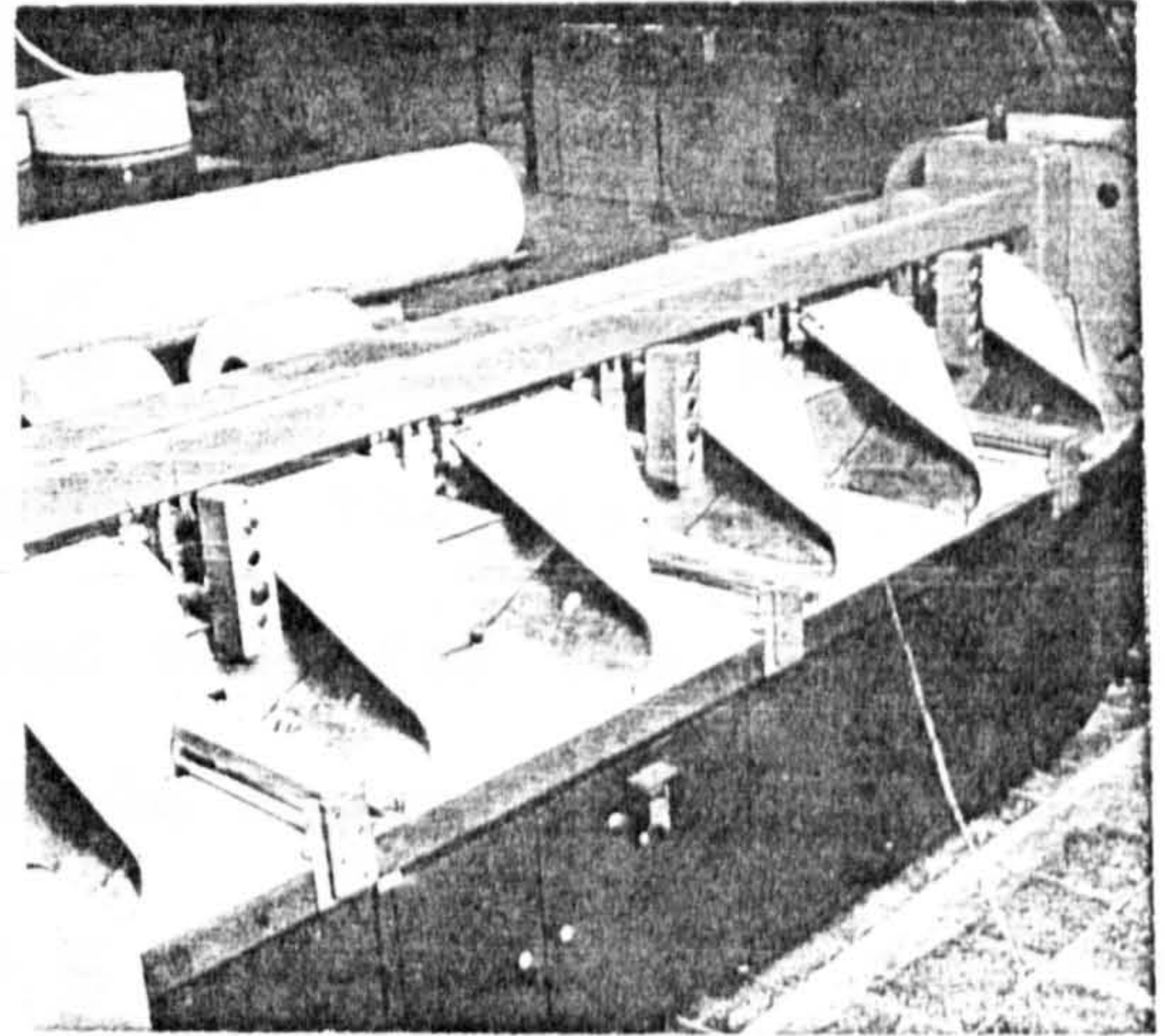


Fig.11.



Fig.12.

Fig.10. Preparation of labs for the combers

Fig.11. Comber

Fig.12. Drafting machines

additional strength needs to be imparted before it enters the spinning process. This is accomplished by twisting it slightly through roving machines ..Finally, the transformation of the sliver to yarn is traditionally achieved by twisting it in spinning machines (fig. 13) at high speeds. The spinning process is always followed by the winding of the yarn on to a bobbin, tube or cone so as to be ready for the process of weaving.

There are two basic stages before weaving: the warp preparation and the weft preparation. The preparation of the warp is more complicated than that for the weft. Warp yarns having been wound on suitable cones, bobbins, spools etc. are subsequently placed in a creel (fig. 14) gathered in a rope and wound on to the warpers' beam (fig. 15) which has the same width as the fabric to be made. Warping yarns require a sizing treatment to acquire sufficient strength to withstand the stresses to which they are subjected in the loom.

Weft preparation varies according to the weaving process depending on the use of conventional or unconventional looms. In conventional looms weft threads are attached to a shuttle which carries them transversely through the warp threads. In unconventional looms the shuttle is eliminated and replaced by rapier, water jet, air jet, ripple or wave shedding⁶.

With the finishing operation the process of fabric making is completed. The packing which follows varies according to

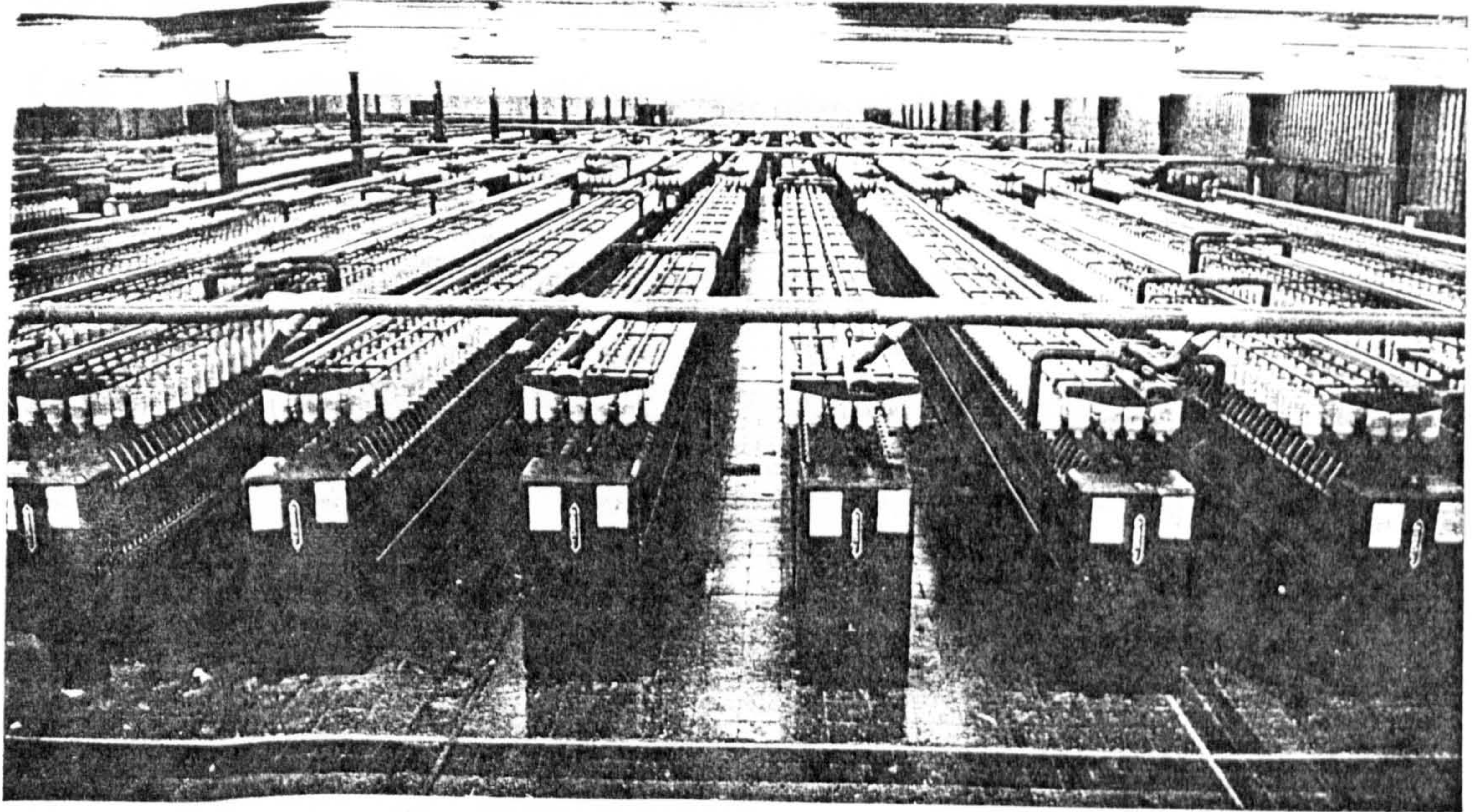


Fig. 13. Spinning machines

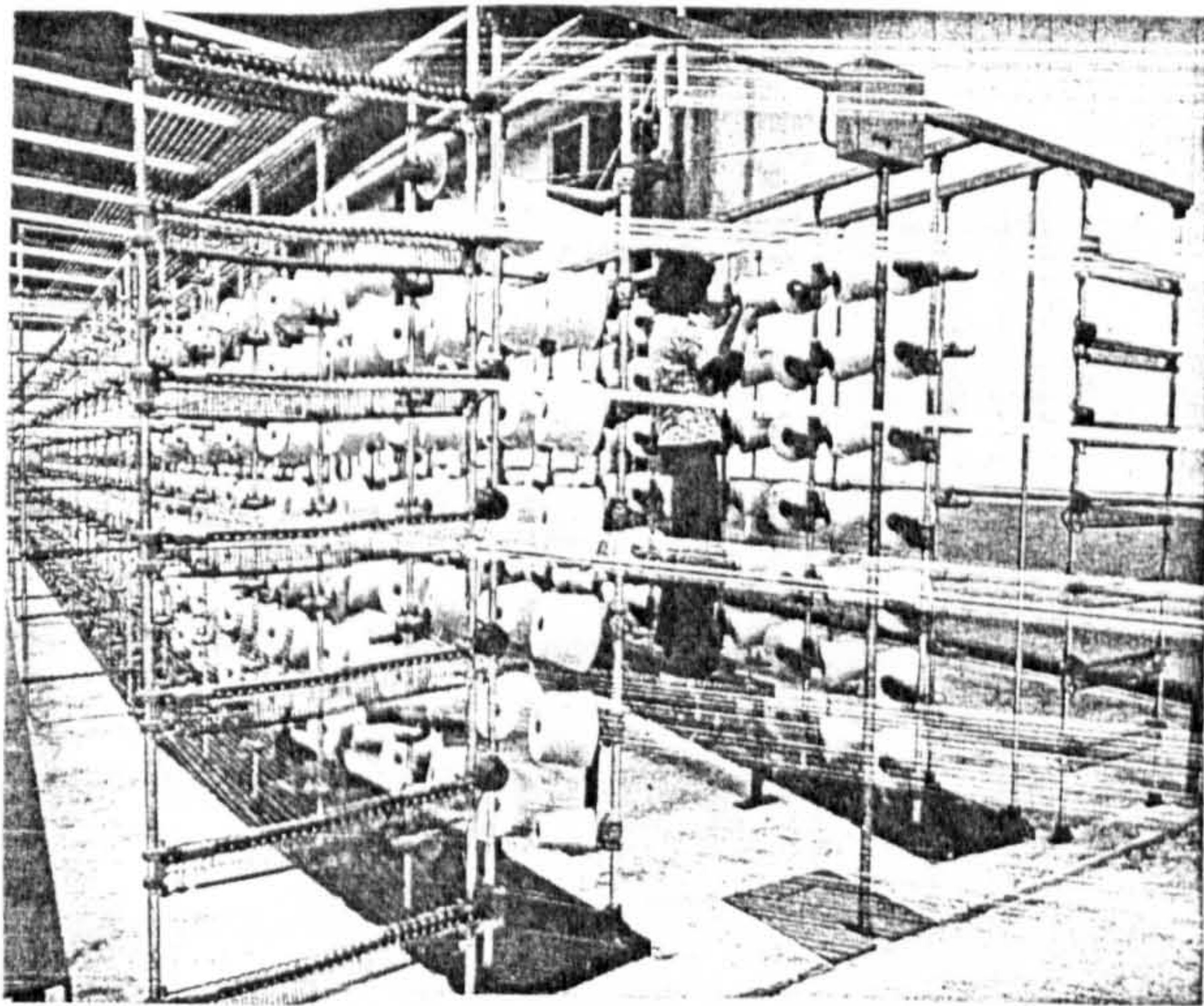


Fig. 14. Creel

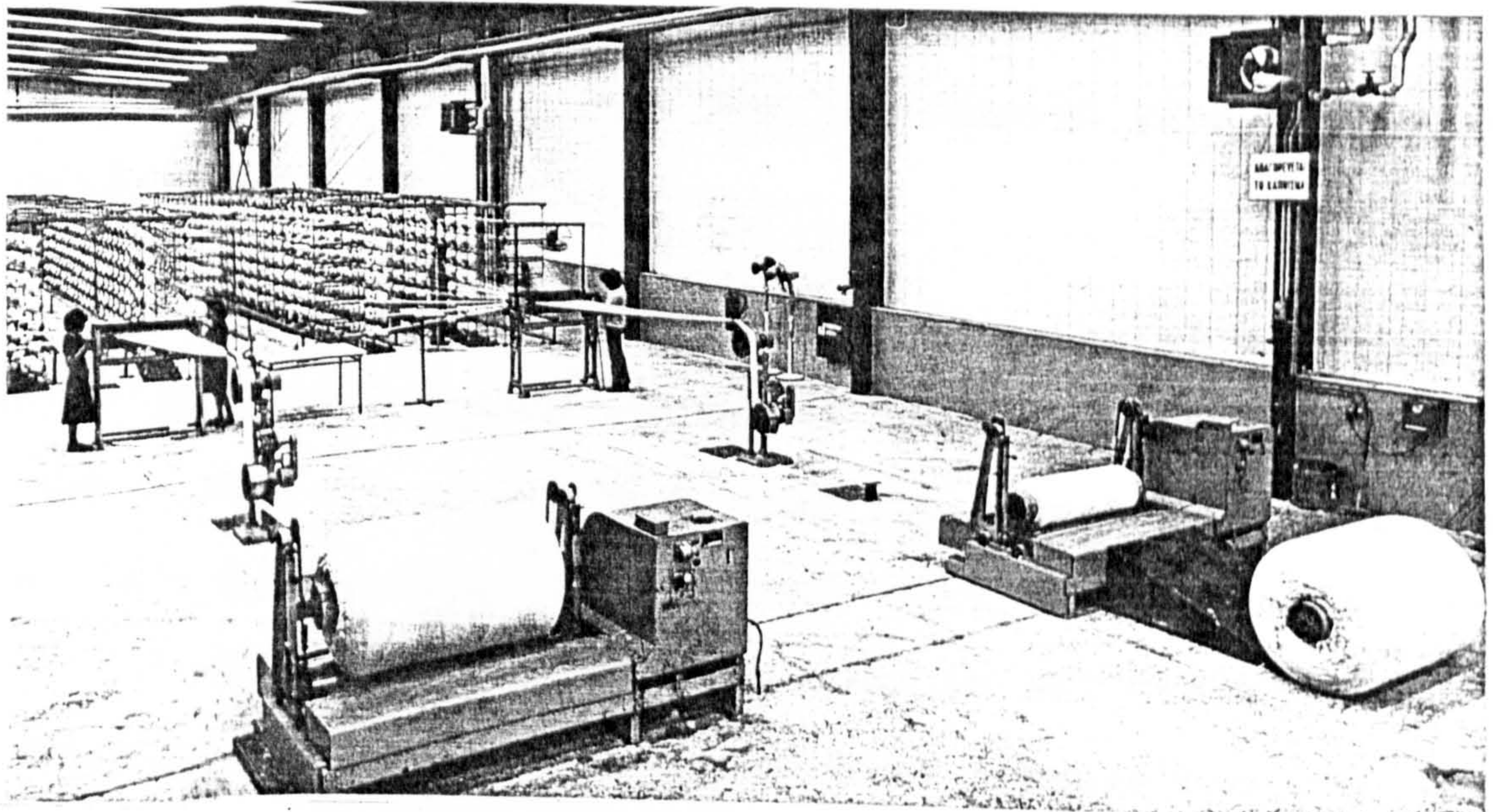


Fig. 15. Warp preparation

the commercial orders involved. Apart from these fundamental functions which are directly related to the production, there are some auxiliary operations concerning the quality control of the product at all stages of its production.

Although the fundamental principles of spinning processes are common to textile industries irrespective of the raw material, there are some differences in the processing system and machinery in cotton, wool and synthetic fibre spinning industries. These differences can have a potential impact on the articulation of spaces in the factory and an influence on the required environmental conditions.

For instance, the production of man-made fibres, which involves the use of many toxic and flammable substances, requires separate storage and fibre processing facilities from the main workshop which are not necessary in the cotton and wool industries. However, in only one building of the survey (A.52)⁷, which produces synthetic yarns, is the production and storage of fibres separated, and the connection with the yarn processing plant is achieved with an automated pipeline feed system.

In the wool industry the stage of raw material cleaning needs special machines and space since it is rather complicated due to the fact that the contained impurities in the wool (grease, suint, sand, dirt and vegetable matter) are not easily disposed of. However, in all Greek wool industries this phase is eliminated because the wool was always and still is imported ready cleaned. Furthermore, the two different processing systems in the wool industry - the

woollen and worsted⁸ - have an influence on the design of the machinery and the environmental conditions - especially on humidity and temperature - but do not seem to have any effect on the building.

If the particularities of processing cotton, wool or man-made fibres have not substantially influenced mill design and construction, the technical developments of the textile machinery certainly have. The term 'technical developments' does not refer to improvements of individual machines derived from the need to increase the output and diminish hazards and workers' accidents, but is related to fundamental changes occurring in the system of machinery as a whole. For instance, the replacement of the traditional system of motive and transmission machinery by individual motorized drives was a revolutionary change and opened a new era of planning flexibility.

The first mills in Greece used steam engines or turbines (fig. 16) actuated by water power which was carried from neighbouring waterfalls with a series of pipes.

According to the owner of the firm, SIGARAS, C., WOOL INDUSTRIES, water power was used to create steam by heating mineral oil in closed tanks wherein there was no oxygen. The temperature of the oil was raised to 200°-300°C and created steam which drove a steam engine. Waterpower to rotate a waterwheel was used only in the SPINNING AND WEAVING MILLS OF EDESSA (A.4), in a similar way with the primitive textile factories (fig.17) of the industrial revolution in Europe, which derived from the old watermills for grinding corn (fig.18).

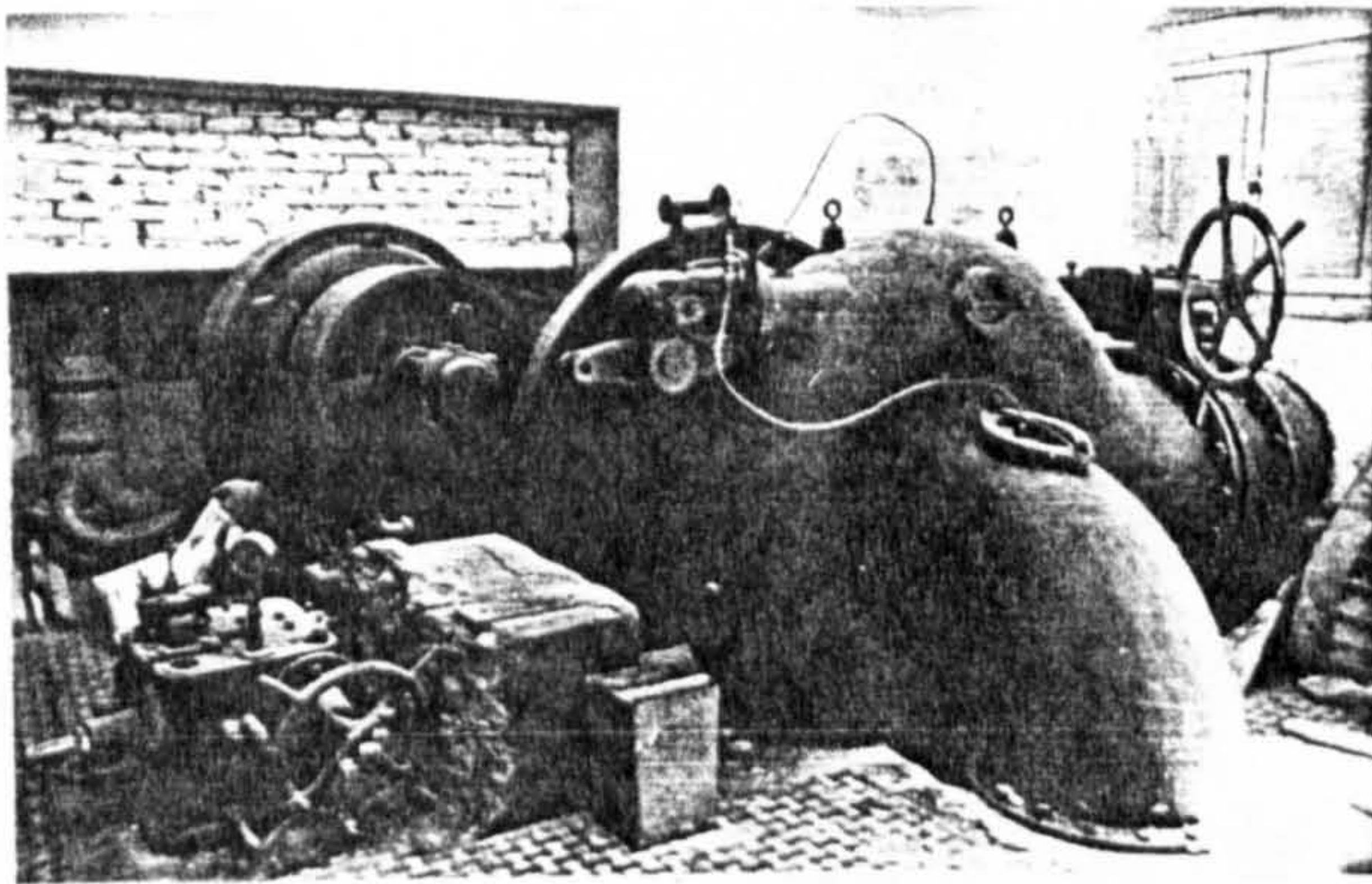


Fig.16. An old turbine which is not in use in 'Varvaressos, Greg. & Co Naoussa Spinning Mills' (A.31), (Naoussa).

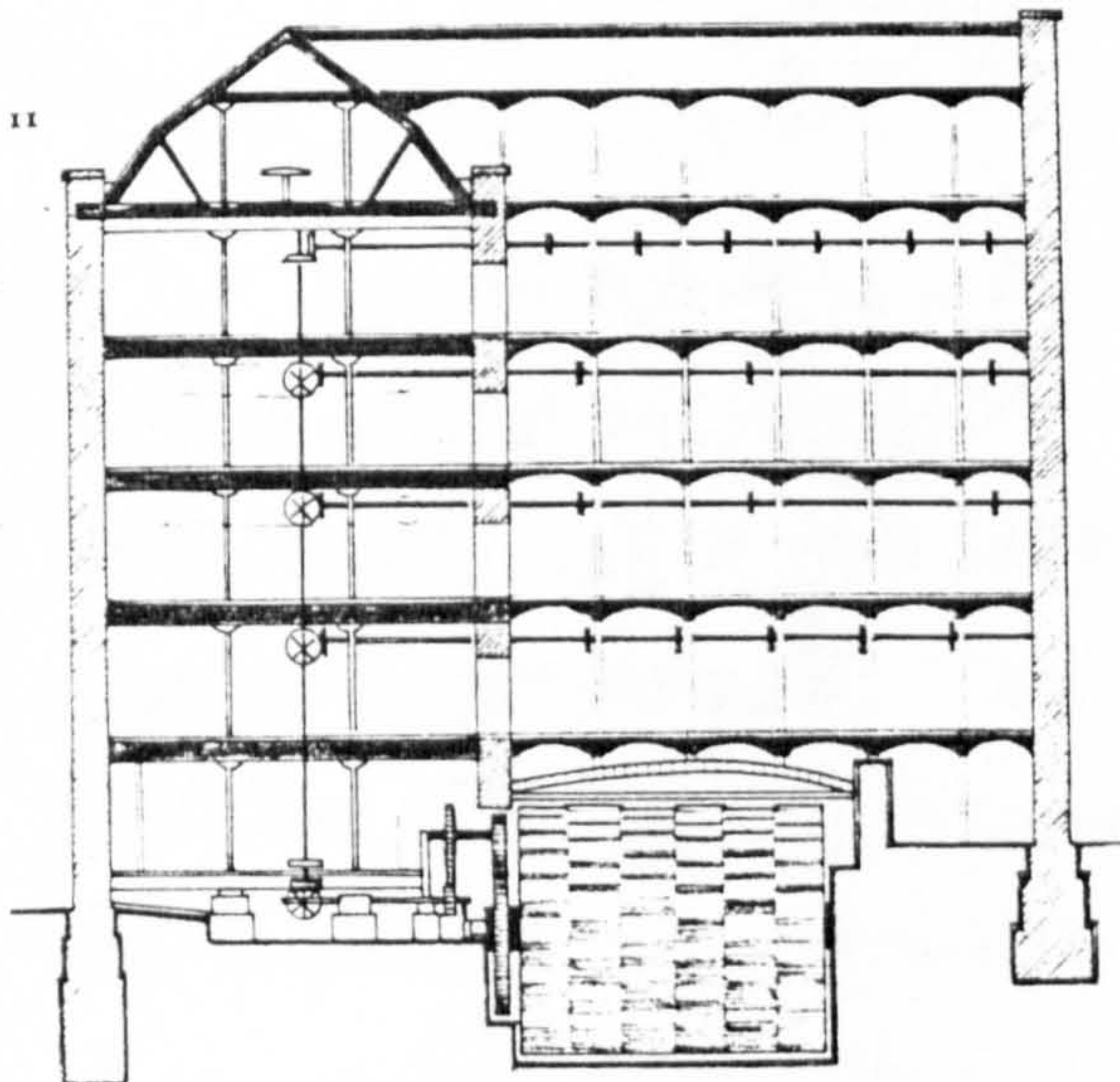


Fig.17. Belper North mill, 1803, (England)⁹

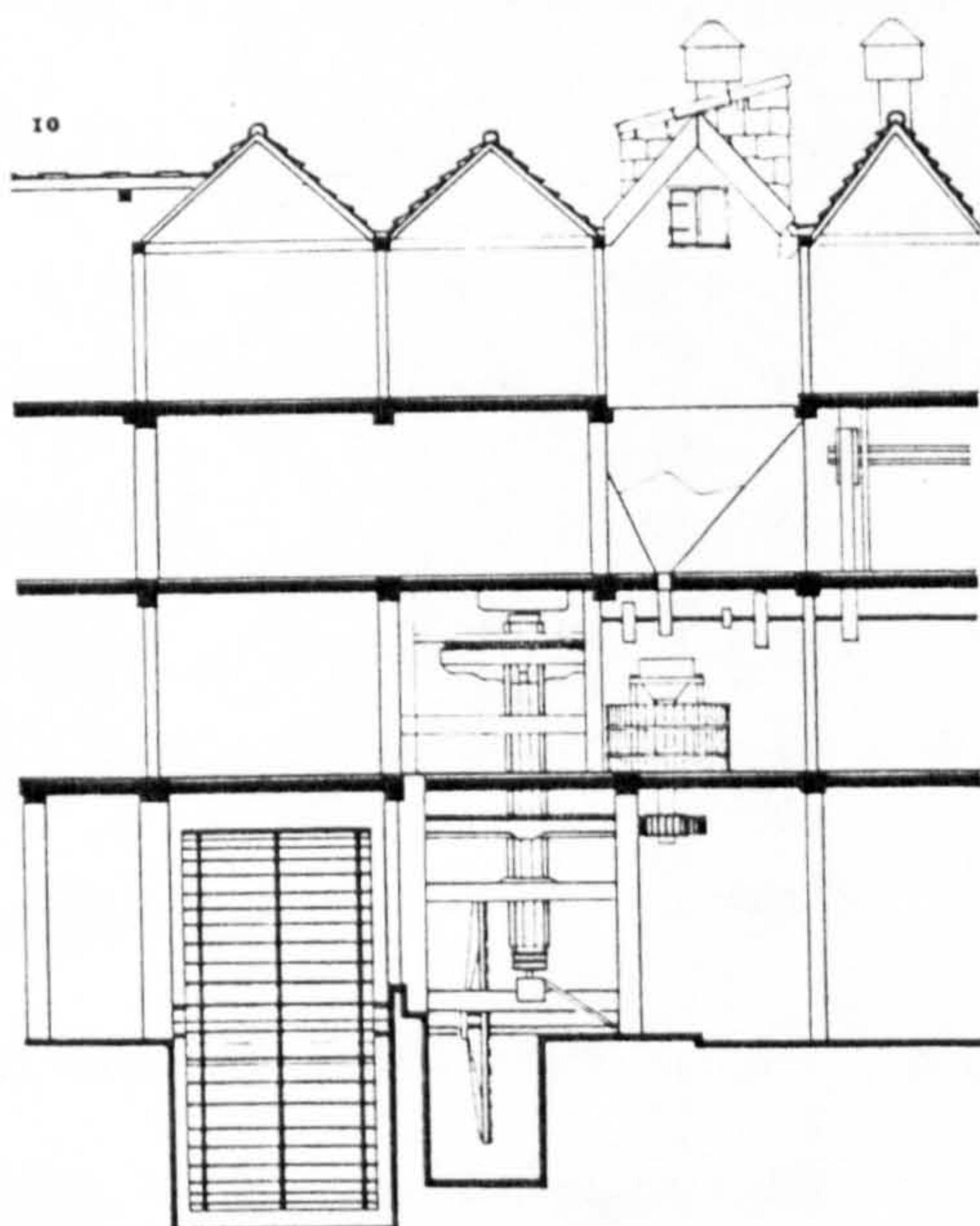


Fig.18. Horstead mill, 1789, (England)¹⁰

The power was transmitted through long overhead shafting to hundreds of individual machines. Apart from the shafting, transmission machinery included pulleys and belts by which other machines were driven. Until the inter-War period few of the old textile mills in Greece used this system of dependence of individual machines on a common source of power usually placed in a separate space. In figs 19, 20 and 21, a few of these machines are illustrated. These belonged to three firms of the survey.

At the beginning of the '20's steam engines and water turbines started being replaced by diesel engines in the shaft drive system and later on by electric motors. The gradual displacement of the old motive engines between 1926 and 1928 is illustrated in table 10. The table refers to the manufacturing sector as a whole. However,

Table 10: IMPORTATION OF MOTIVE ENGINES IN GREEK INDUSTRY,
1926, 27, 28

MOTIVE ENGINE		1 9 2 6		1 9 2 7		1 9 2 8	
		N° of units	Total HP	N° of units	Total HP	N° of units	Total HP
Diesel engines	HP	329	17,440	630	19,106	834	26,532
Petrol "	HP	6	87	5	10	5	36
Steam "	HP	4	476	1	-	2	183
Gas operated "	HP	2	87	3	140	1	13
Turbines	HP	5	1,049	2	1,442	11	1,582
Electric engines	HP	569	3,785	940	5,509	1,021	7,849
Electric generator	KW	79	5,117	117	4,763	159	6,956



Fig. 19.

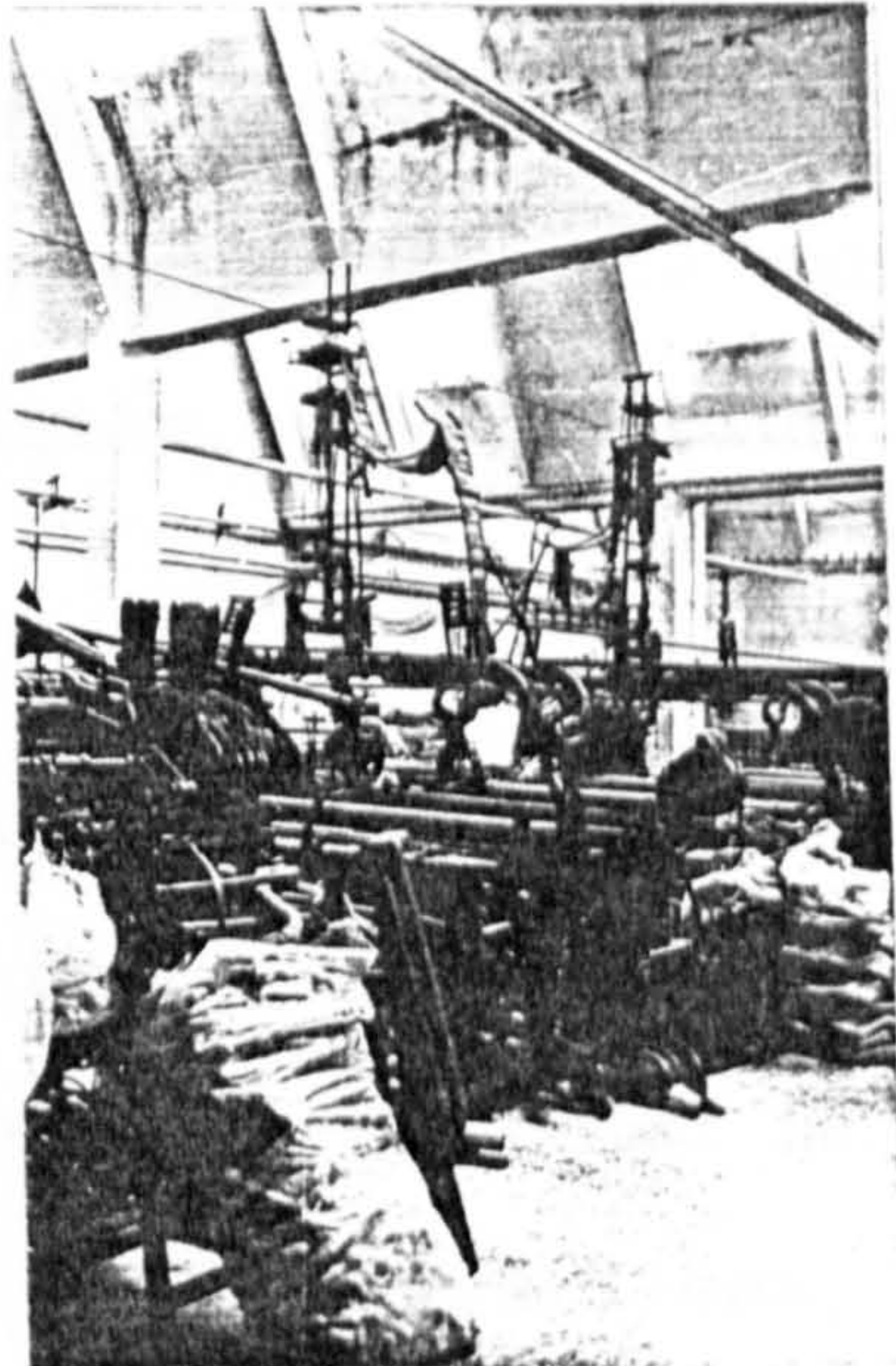


Fig. 20.

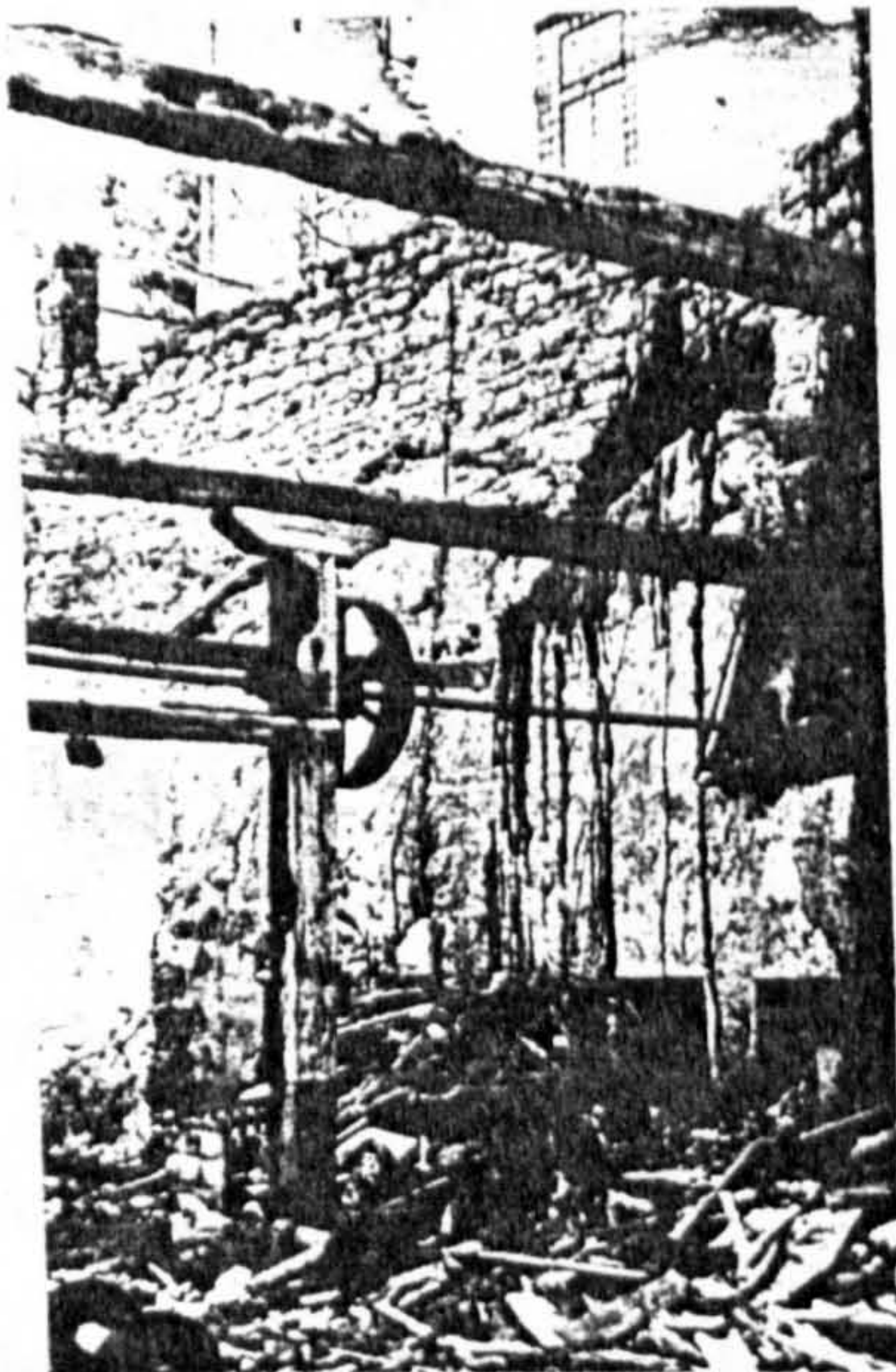


Fig. 21.

Fig. 19. Interior of 'Pierrakos Textile' mill (A.3). The shafting system is illustrated in the background (Thessaloniki)

Fig. 20. An old jacquard loom in 'Sefeco Wool Industry' (A.11)

Fig. 21. Only one axis of the shafting system is still remaining in the dying department of 'Spinning and Weaving Mills of Edessa', (A.4), (Edessa)

Source: N. SIDERIS, The Importation of Motive Machines for
Greek Industry during 1926, 1927, 1928 , (in Greek),
in ERGA, Magazine of Industry, Transport and
Constructions, N° 92, 30 Mar 1929, p.576

considering that textiles were one of the most important branches of Greek industry during those years, with a high degree of mechanization, we can assume that the table illustrates, with a good approximation, the situation of the textile sector.

The rapid introduction of diesel engines and large electric motors as power sources for the shaft drive system is shown clearly in a number of advertisements published in 'Erga', Magazine of Industry, Transport and Constructions, and later after 1932 in the official magazine of the Technical Chamber of Greece¹¹ the 'Technica Chronica'. The plenitude of the advertisements refers to imported textile machinery from Belgium, Britain, Holland, Germany, Denmark and Italy (fig. 22).

Later on by the mid 30's small electric motors attached to individual machines replaced the line shafting and belt drives (fig 23 and fig 24). Every machine could be placed in any position and could operate at various speeds independently of the others. The first small electric motors were advertised in 'Technica Chronica' on the 15th of January 1936 (fig. 25), but their extensive use started in the post-War years. It has to be considered that the advent of electric lighting occurred only at the very begin-

BUTTERWORTH & DICKINSON LTD
BURNLEY (ENGLAND)

ΚΑΤΑΣΚΕΥΑΣΤΑΙ ΥΦΑΝΤΙΚΩΝ ΜΗΧΑΝΗΜΑΤΩΝ
ΓΙΑ ΒΑΜΒΑΚΕΡΑ, ΜΑΛΛΙΝΑ & ΛΙΝΑ ΥΦΑΣΜΑΤΑ

ΚΑΡΟΥΑΙΣΤΡΑΣ όλων των τύπων
ΜΑΣΟΥΡΙΣΤΡΑΣ βαρέως
ΣΙΑΣΤΡΑΣ διὰ λινού και χρηματιστά σιγρόντα
ΤΥΛΙΚΤΡΑΣ
ΑΝΑΜΙΚΤΑΣ ΚΟΛΛΑΣ
ΚΟΛΛΑΡΙΣΤΡΑΣ τού στήμονος, κλπ. κλπ.

ΙΣΤΟΥΣ ΜΟΝΟΣΑΪΤΟΥΣ ΑΠΛΟΥΣ
ΙΣΤΟΥΣ ΠΟΛΥΣΑΪΤΟΥΣ
με ΡΑΤΙΕΡΑΣ
· ΔΙΠΛΟΦΑΡΟΥΣ
· ΕΙΔΙΚΟΥΣ ΔΙΑ ΠΡΟΣΟΦΙΑ, ΤΡΑΠΕ-
ΖΟΜΑΝΟΥΑΑ, ΚΟΥΒΕΡΤΑΣ, κλπ.
· Επίσης, ΔΙΠΛΩΤΙΚΑΣ ΜΗΧΑΝΑΣ,
ΥΔΡΑΥΛΙΚΑ ΠΙΕΣΤΗΡΙΑ κλπ.

ΑΔΕΛΦΟΙ Γ. ΓΡΗΓΟΡΙΑΔΟΥ
ΘΕΣΣΑΛΟΝΙΚΗ - ΑΘΗΝΑΙ - ΣΜΥΡΝΗ
14 ΕΛΕΥΘΕΡΙΟΥ ΛΟΓ

· Αντιπρόσωποι των ανωτέρω Κατασκευαστών
δι' όλην την Ελλάδα.

· Έκπονοσι μελέτας, προκοφάς και αναλαμβάνουσι
· εργασίας όλες των υφαντοργείων
· διὰ παντός είδους υφάσματα.

· Επίσης προμηθεύουσι όλα τα εξαρτήματα,
· δι' υφαντοργεία, ως: Μυτέρια, Κέντνια, Σαΐτας,
· Μασούρια, Καρούλια, Λογάρια βελώνων κλπ.
· από τα καλλίτερα Άγγλα Έργαστήρια και εις
· τιμής συγγαυταθείσας.



Fig.22. The first advertisement for textile machinery. It appeared in 'Erga' on the 30th of March 1929

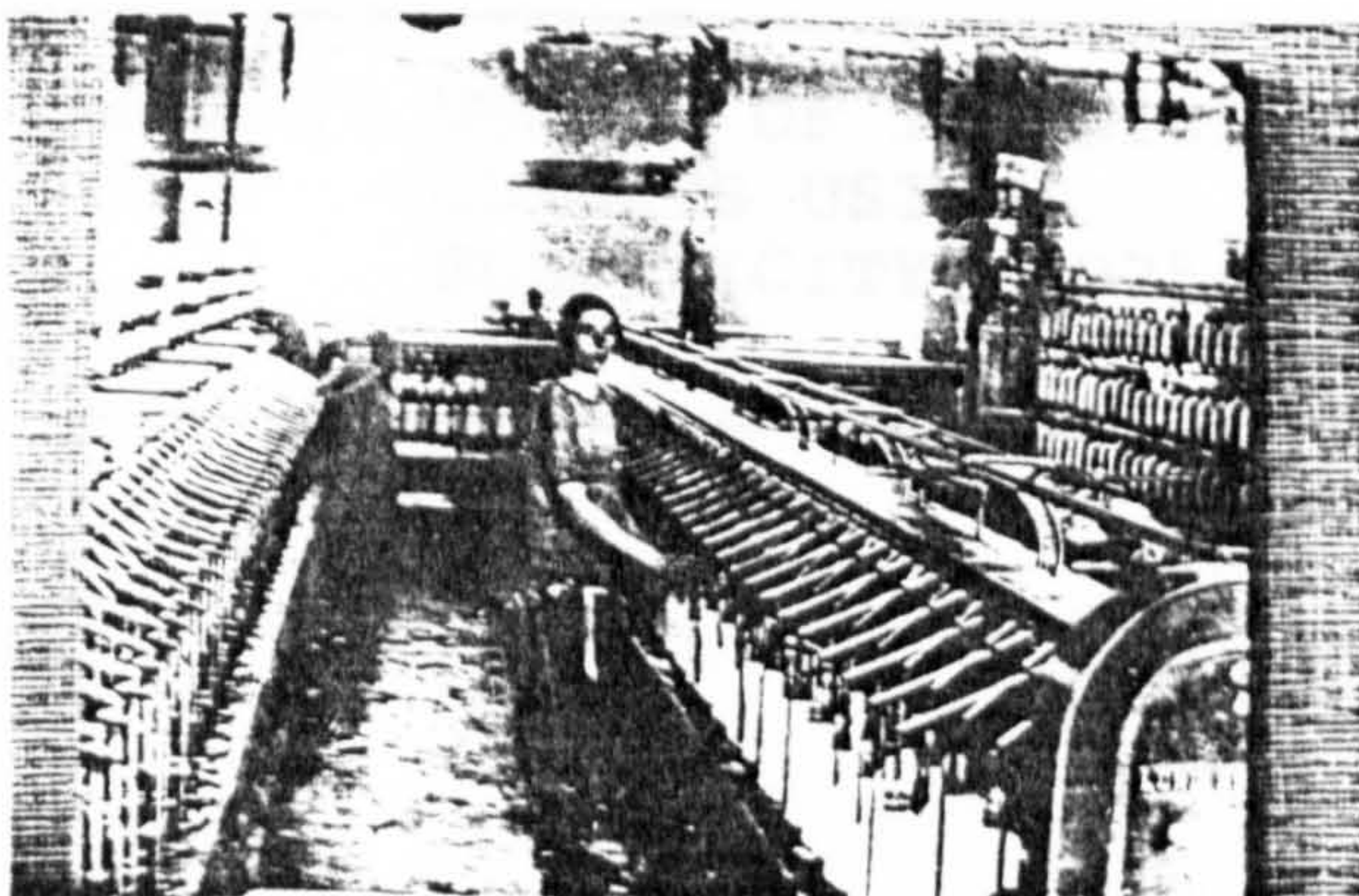


Fig.23. Interior of 'Varvaressos Greg. & Co Naoussa Spinning Mills' (A.31). The electric motor is illustrated (Naoussa)

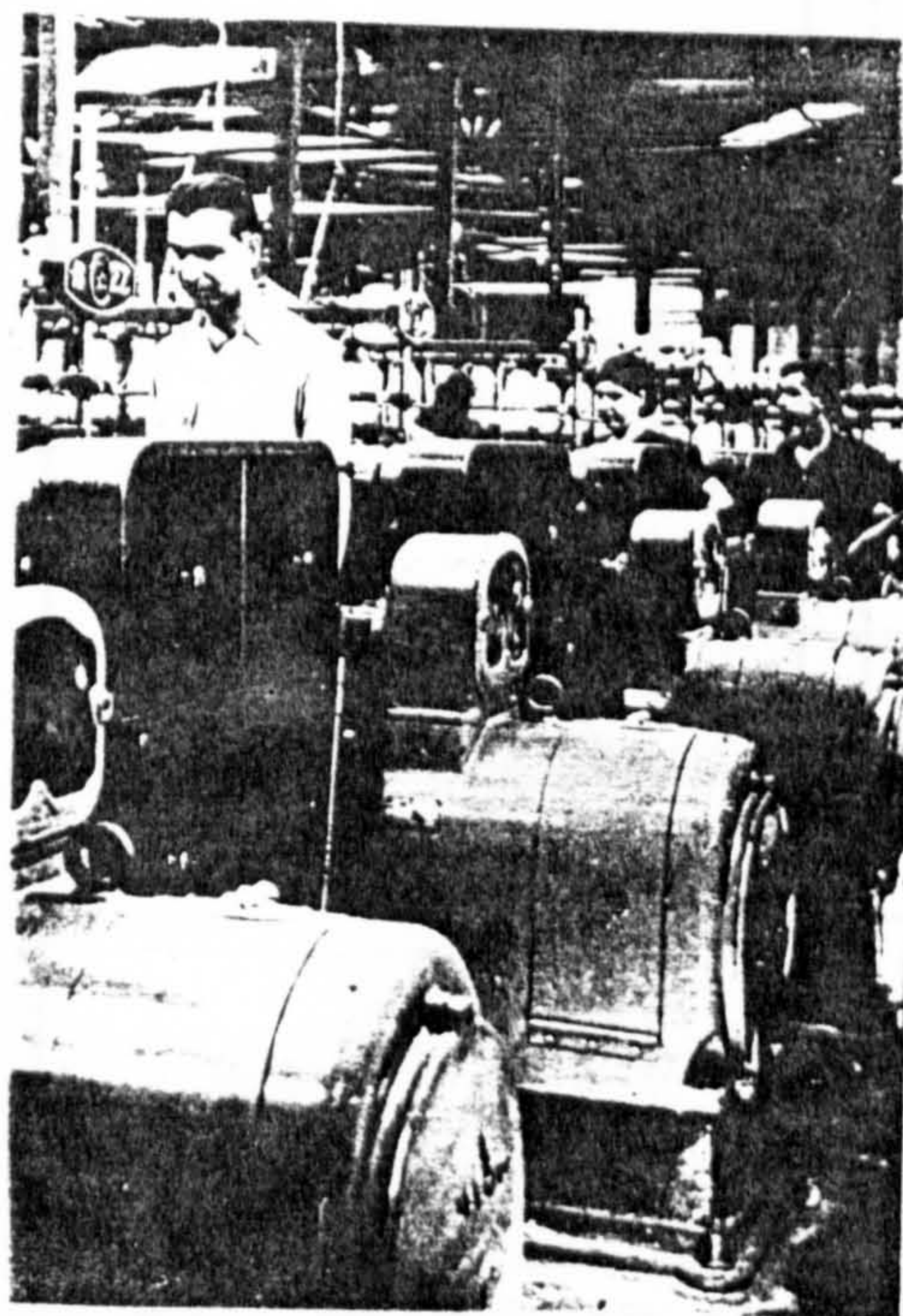
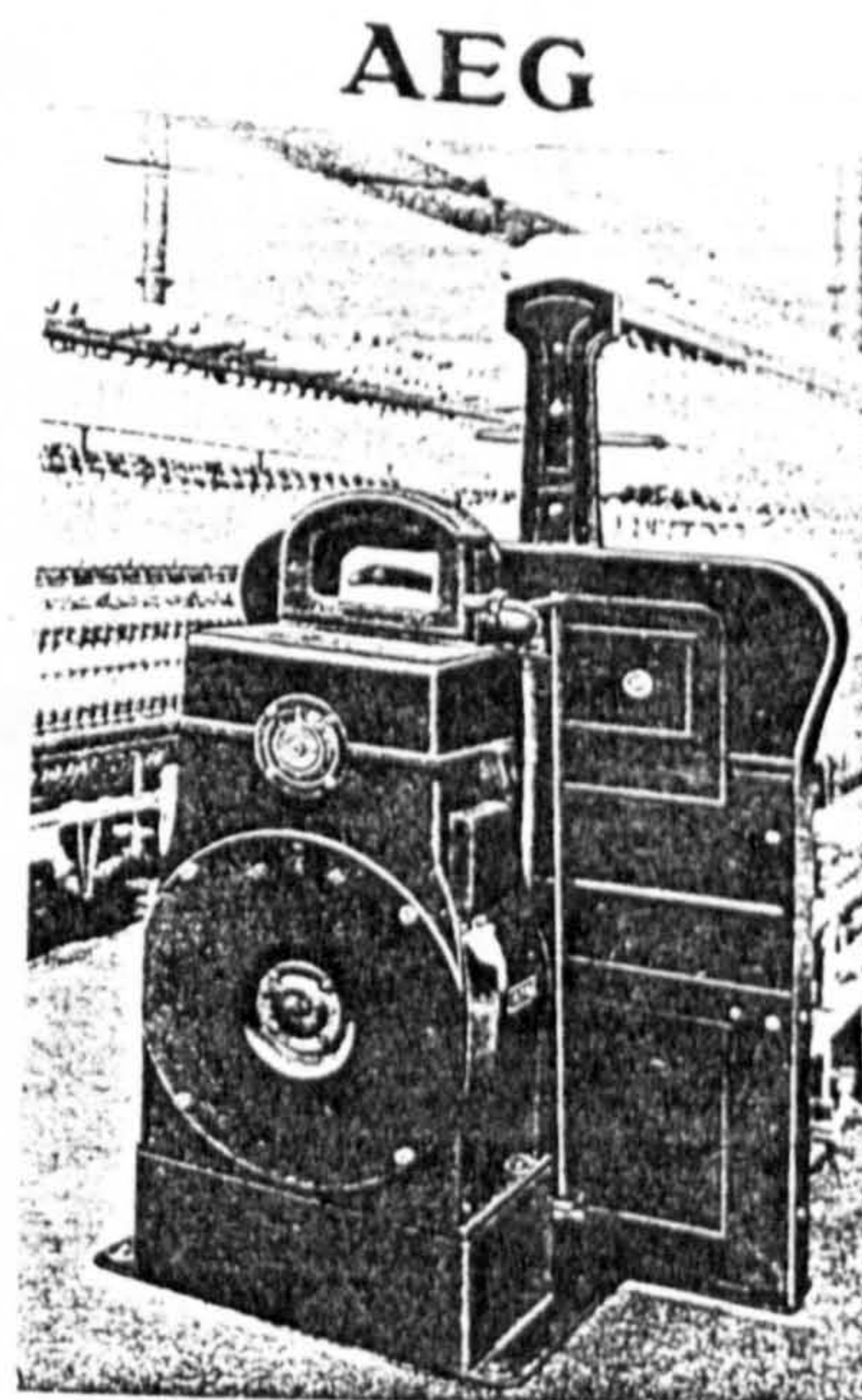


Fig.24. Interior of 'Pierrakos Textile' mill (A.3) (Thessaloniki)



· Ηλεκτροκίνητος κλωστικός μηχανής διὰ τριφασικού κινητήρος μετά
· συλλέκτης εν ρεϊθέρ και αυτόματου ρυθμιστού κλώσεως ·

Fig.25. The first advertisement of electric motor

ning of the century with the establishment of the first power station¹² which produced electricity for the lighting of the city of Athens. Nevertheless, the industrial use of electricity took place later and as is illustrated in table 11 and 12, showed a dramatic increase in the decade 1925-1935. The implications of this technical development were important not only for factory design and construction but also for environmental conditions on the shopfloor, which are analysed in the next section.

TABLE 11. NUMBER OF INDUSTRIAL CLIENTS USING ELECTRICITY: 1925-35

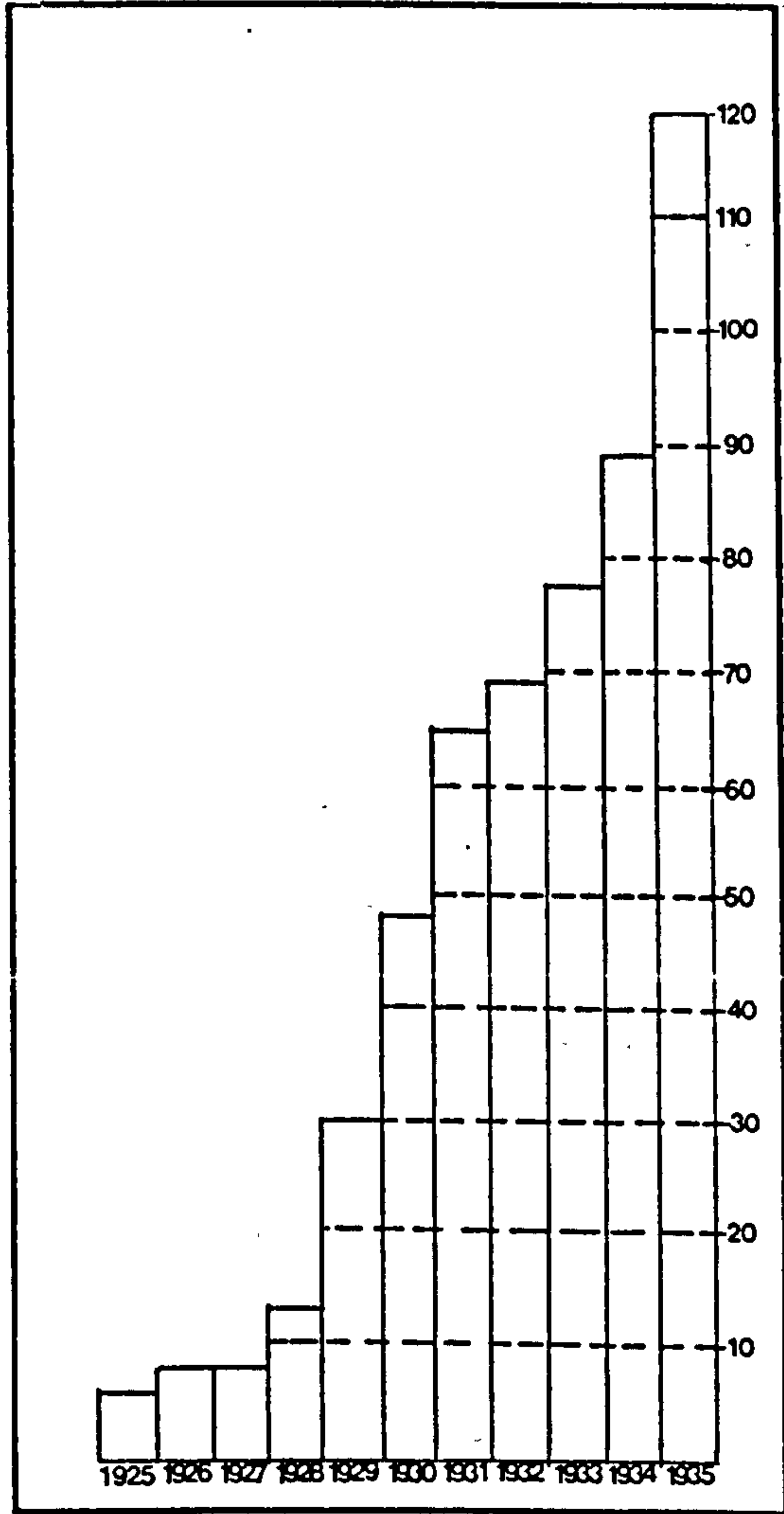
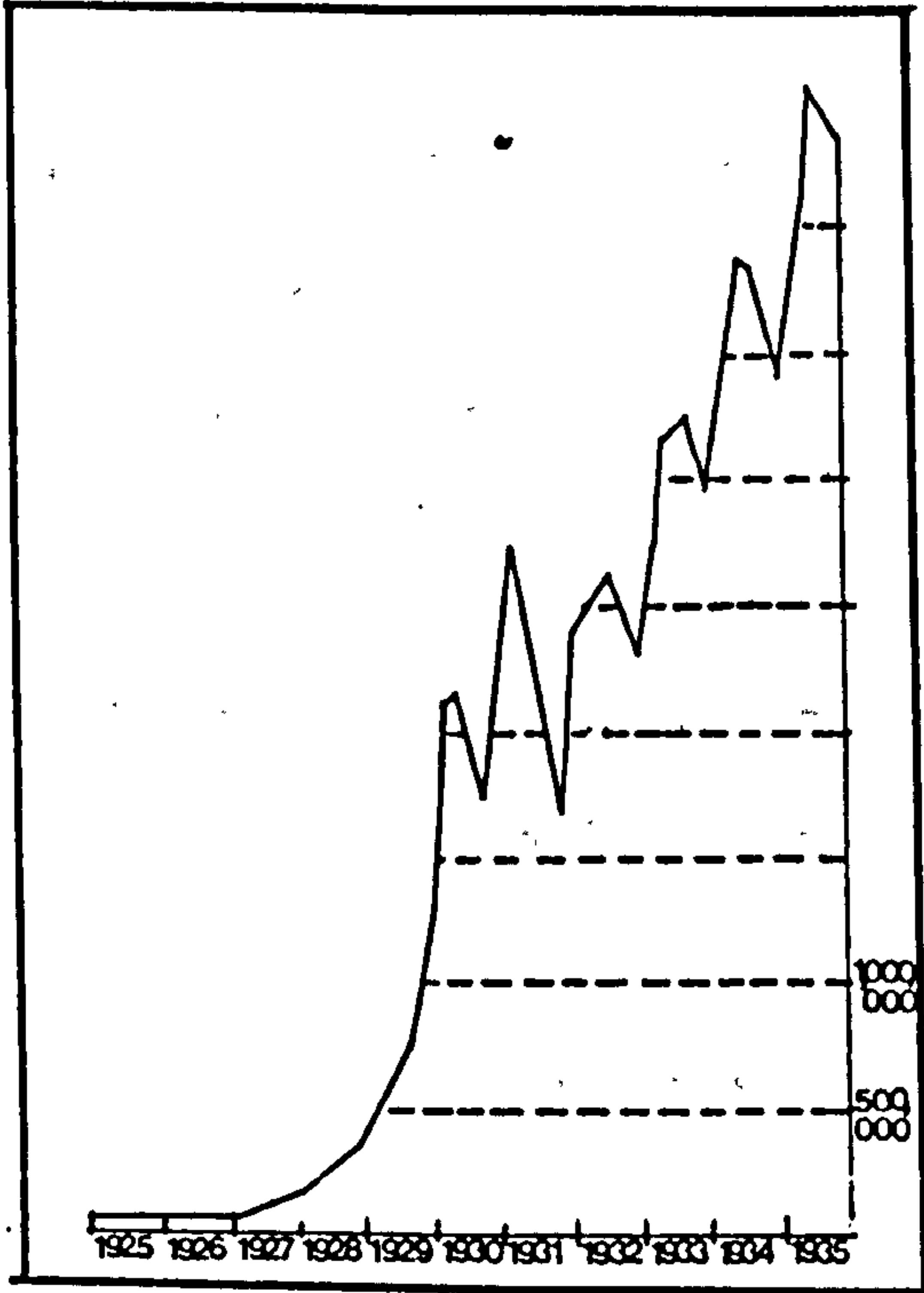


TABLE 12. THREE MONTHLY CONSUMPTION OF ELECTRICITY IN INDUSTRY: 1925-35



Source: Report on the use of electricity in Athens for a decade (in Greek), TECHNICA CHRONICA, 1 Jul. 1936 pp. 601 and 602

2.2. ENVIRONMENTAL CONDITIONS: THEIR POTENTIAL EFFECT ON DESIGN

The environmental conditions in textile plants, as in all working premises, should provide safe and healthy conditions for employees, and for the quality of products. Safety problems are associated with hazards caused by unguarded and uncovered moving parts of machines, by handling heavy loads, by electricity and by fire and explosives¹³. Measures to prevent these affect matters such as the workshop layout, the design of machines and equipment, and the planning of work. However, these preventive measures do not have a substantial influence on factory design apart from those associated with fire prevention and especially those related to compartmentation and structural prevention, which affect the articulation of spaces and the building materials.

Health problems are mainly caused by high noise levels, the effects of dust from raw materials (cotton, wool, flax etc) on the respiratory tract, and the high temperatures combined with high levels of humidity required by the processes.

Textile machines are very noisy particularly automatic shuttle looms. The excessive noise to which the workers are exposed for many hours per day has a detrimental effect on their general health, on their hearing and on their working performance. Measures to control noise do not have any substantial effect on the design of building. However, noise as a factor of disturbance to the surrounding area may

condition the location of the factory on the site, the choice of the site itself, and the choice of building materials.

The effects of dust are varied depending on the type of raw material. The industrial diseases found in the textile industry are byssinosis, mill fever, weaver's cough, anthrax, shuttle kissing¹⁴ and mule spinner's cancer. According to the Textile Committee of the International Labour Organization "there are three principal methods of controlling exposure to textile dusts ... the first is to eliminate at source, or to reduce, the biologically active component in the dust; the second is to reduce airborne concentrations in workrooms of the dust which contains the agent(s), and the third is by means of respirators"¹⁵. In addition to all these which are aspects of environmental control there should be regular medical surveillance. All of these measures, however important, affect the design of the factory only to the extent that they make necessary a good ventilation system whether natural or artificial.

Natural ventilation is based on the combined effects of wind and temperature difference between the internal and external air of the building. It is affected by the general roof outline of the factory and the position, type and size of side windows. In contrast, mechanical ventilation does not influence the form of the roof since it requires only enough space under the roof for ventilation ducts. At the beginning of the twentieth century in Europe many companies were concerned with carefully studying heating and ventilating problems. Treatises on design and construction of factories¹⁶ provided various types of roofing systems, monitors, ventilators and box skylights with an analysis of their

advantages and disadvantages. However, dependence on natural ventilation gradually diminished and was displaced by mechanical¹⁷ and air conditioning systems.

The environmental conditions required for the quality of products - high temperature combined with high levels of humidity - should be carefully considered to create, at the same time, climatic comfort for the workers. The various stages of processing require different levels of temperature and humidity. The optimum thermal conditions called for in spinning and weaving process, vary according to the type of fibres being used as can be seen in table 13.

Table 13: ATMOSPHERE IN TEXTILE FACTORIES

	Temperature	Humidity
	°C	RH%
<u>WOOL-SYNTHETIC FIBRES</u>		
Scouring	27 - 30	
Carding	20 - 24	55 - 70
Gilling	20 - 21	60
Combing	21 - 24	70 - 85
Twisting	20 - 21	60 - 70
Spinning	20 - 23	50 - 70
Weaving	20 - 22	60
<u>COTTON</u>		
Opening	22 - 23	50
Carding	21 - 24	45 - 55
Combing	22 - 27	55 - 65
Twisting	22	60
Spinning	22 - 24	70 - 75
Bobbing	24	55
Weaving	18 - 20	60 - 80

Source: M. BOURDERIOUX, 'Les Ambiances de Travail dans l' Industrie Textile', Caisse Régionale D'Assurance Maladie du Nord de la France, 11 Boulevard Vauban, Lille, 16 Oct., 1975, p. 7

The practical difficulties of achieving and maintaining control of different levels of temperature and humidity resulted in the introduction of automatic control of humidity, temperature and air movement. It was mainly in the post-War years that the introduction of individual motor drivers substantially increased the heat in work-rooms and made difficult the achievement of the necessary standards. Natural ventilation combined with a heating system were not enough to provide a comfortable environment for the workers and satisfactory conditions for the processes.

An important aspect of environmental conditions, which contributes to a great extent to the feeling of comfort of the employees, is lighting. Furthermore, lighting is, according to J. Drury, "a major interface between architectural and service design with an impact upon the basic building concept and probably affecting the choice of factory structure, roof design and building orientation"¹⁸.

The minimum and maximum illumination requirements are not the same for various stages of textile processing. In addition they have changed substantially during the last four decades as appears from the comparison of table 14 with table 15.

The proper standards of illumination can be achieved with natural daylight, artificial, or combination of both. Though

Table 14: RECOMMENDED IL-
LUMINATION
REQUIREMENTS IN
LUX (in 1951)

<u>COTTON</u>		
carding	30 -	60
gilling	30 -	60
spinning	50 -	100
weaving	50 -	100
bobbins	50 -	100
<u>WOOL-SYNTHETIC FIBRES</u>		
scouring	30 -	60
carding	30 -	60
combing	30 -	60
gilling	40 -	120

Source: L.GRIVEAUD, op.
cit., p.p.485-86

TABLE 15: RECOMMENDED IL-
LUMINATION
REQUIREMENTS IN
LUX (in 1975)

<u>COTTON</u>	
carding	200
gilling	200
spinning	300
weaving	500
bobbins	300
<u>WOOL-SYNTHETIC FIBRES</u>	
scouring	150
carding	300
combing	500
gilling	200

Source: M.BOURDERIOUX, op.
cit., p. 14

the essentials of good lighting have always been the same during the last eighty years¹⁹, the means to achieve the current standards of visual efficiency have changed a great deal. Natural lighting was preferred to artificial, until the Second World War, on the basis of health and economy. The first multi-storey buildings of the industrial revolution received exclusively daylight from side windows. From the end of the nineteenth century the increased area of production halls, and the flexibility required by the process favoured the single-storey deep building. The standards of lighting

could not be achieved with only side windows. As E. G. Souster pointed out in 1919, referring to all kinds of industrial activities, "in modern factories where lateral lighting is employed a large part of the walls are devoted to windows, but it is evident that there is a limit to the width of the room beyond which the illumination falls below what is adequate"²⁰. Lighting from side walls varies according to the size and height of the windows. A rough calculation shows that a shopfloor can be sufficiently illuminated from side windows if its width is no more than four times the height of the windows²¹. Consequently, skylighting industrial buildings with longitudinal and transverse monitors, box skylights or saw tooth roof windows were preferred. In textiles side windows caused problems of glare to workers. As the worker was inspecting a number of machines which were placed at right angles to the side walls and in parallel order, he had to orientate himself alternatively towards and away from the windows. His continuous movement from excessively bright areas to less bright ones produced an inability to see accurately and mental fatigue with a diminishing of his working performance and health. Lighting from the roof reduces the risk of glare but may create problems of leakage, heat loss and solar gain especially in warm climates. In Europe the use of saw tooth roof constructions was already a reality in the 1860's (fig. 26, 27).

The idea of windowless air conditioned factories, advocated after World War Two in the United States is, according to many Europeans²⁴, an expensive luxury which can also create psychological problems for workers. However, it is

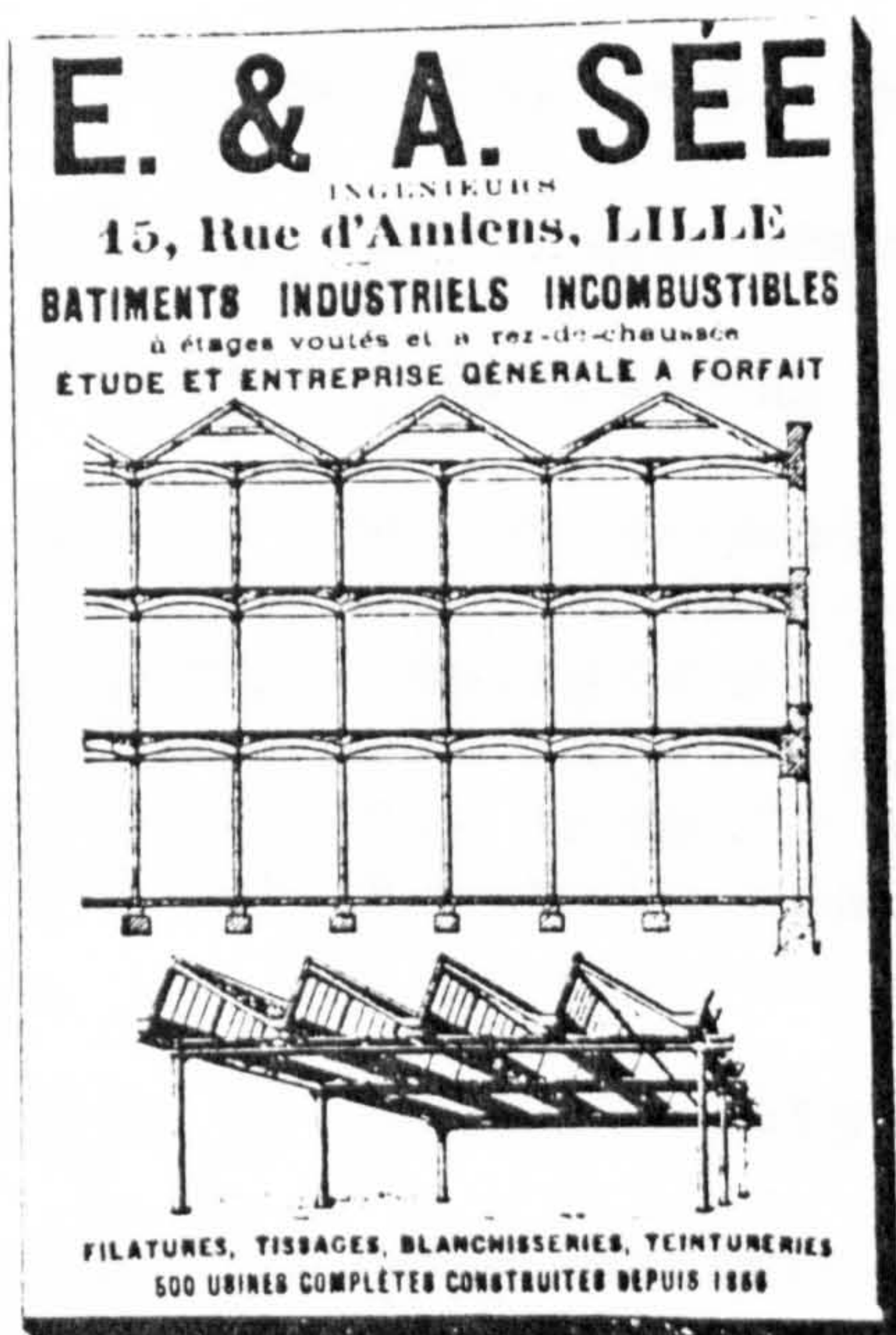


Fig.26. Advertisement for mill constructions in 1863²²

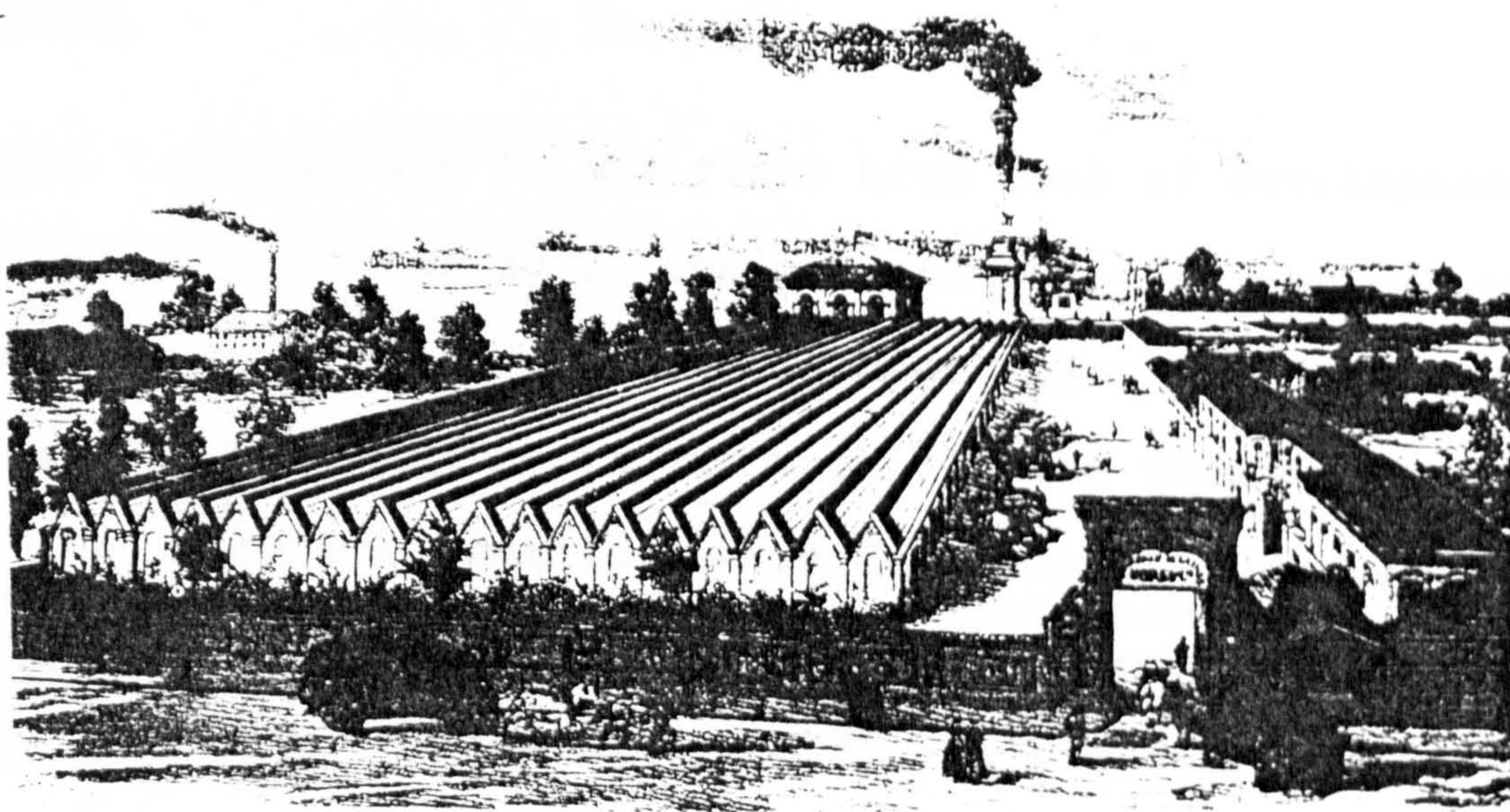


Fig.27. Wool mill in Roubaix 'Morel e Cie' App. 1860²³

generally agreed that in cases where the production process needs a constant high quality of conditions, the windowless building should be preferred.

Textile manufacturing falls into this category. The strict environmental requirements and dependence upon windows for natural lighting create problems which are mutually antagonistic. According to the report of the Textiles Committee of the International Labour Organization "this fact favours the windowless factory provided all the associated environmental requirements can be satisfied"²⁵ Similarly O. Grube claims that "north lighting formerly widely used, has few advantages, save in special industries such as textiles and and consequently has been practically abandoned"²⁶.

Only with difficulty can one claim that there are satisfactory environmental conditions in Greek factories in general and textile ones in particular, except in very few cases.

When industry was at its first high peak of development at the end of the 20's, the conditions in factories were extremely poor. Eliot Grinnell Mears gave an idea of the appalling conditions in his book 'Greece Today'. He wrote:

"Poor light and ventilation in factories, inadequate sanitary provisions, long hours, night work for women and children and wages lagging behind the rising living costs. On account of the housing shortage, the conditions in most of the factories are pitiable"²⁷. In the same period G.

Lefkaditis wrote an article on lighting in factories in the magazine 'Erga' and claimed that, "Although in our country up to the present time no systematic statistical research and measurements have been carried out in an attempt to examine the lighting conditions in our factories, all those who come into contact with factories are in a position to get to know the very unpleasant real situation ... few of our factories make profitable use of the natural light ... the great majority (of buildings) and especially

the old ones, depict us as extremely backward not only in following the newer technical developments in lighting equipment but also in the application of the elementary rules of good lighting"²⁸.

Even today the situation is more or less the same. The International Labour Office in the recent Blanchard Report²⁹, describes the working conditions in factories as unacceptable. This situation is due to the lack of relevant comprehensive legislation - as will be shown in the next section - and to the difficulty State bodies have in exercising sufficient control. As a consequence, the involvement of the State is insubstantial. Also there are no statutory research bodies in Greece working specifically on occupational health and safety problems. Any research which has been undertaken so far has been done occasionally by individuals or bodies such as the Technical Chamber of Greece³⁰, various Ministries and University departments. The majority of reports refer to the industrial sector as a whole and are more prescriptive than descriptive of the existing situation.

Therefore, it can be hardly claimed that in Greece environmental conditions have exerted any influence on the design of factories. However, in some modern textile factories priority was given to achieving a strictly controlled environment for the production process, and the environmental requirements determined the decisions concerning the basic building concept and its structure.

2.3. LEGISLATION FOR BUILDING CONTROL: ITS INFLUENCE ON DESIGN

Statutory measures that have affected the design of factories are very few. There is a vast legislation concerning industrial development and planning which is related to industrial firms as economic units rather than to their industrial premises. This section describes the most important of the statutory measures that might have had an influence on mill design.

The beginning of the century witnessed the first attempts of the Greek State to abandon its passive role, and to intervene in various sections of the economy. In the course of those years the labour movement, despite being only at a rudimentary stage - there were very few labour unions -, forced the government to pass laws concerning the eight-hour day and health and safety conditions in workplaces. Between 1911 and 1934 a number of related Laws, Royal Decrees and Presidential Decrees³¹ were prescribed.

The most important of these, which was in effect until recently (10/85) was the Presidential Decree 13/22-Mar 1934. This provided a number of requirements concerning issues such as the construction of floors, passages, exits, staircases, lighting, natural and artificial ventilation, air pollution, fire precautions, dangerous machines and equipment, washing facilities, cloakrooms, lavatory provision, first aid boxes, ambulance rooms and catering facilities. The main characteristic of the Decree was that for some issues it was very detailed and specific and for others very general and

insufficient. For instance, in the article referring to staircases, details were given of the size of the rises and treads, whereas the chapter for lighting was general and vague as the following quotation shows: "In every factory, workshop, shop or other establishment as well as in their passages and staircases there should be as long as this is possible adequate daylight, so that work can take place easily and the vision of the worker is protected. The lighting of the shopfloor should be strong and arranged in such a way so that every moving part of the machine is adequately lighted ... The side windows of the saw tooth roofs and the other systems of lighting from the roof of the shopfloor should be spaced between the columns and well spread out, as much as possible, so that adequate lighting will be achieved in the very distant areas of the shopfloor under the usual daily conditions"³².

This barely sufficient Decree was full of general expressions and continuously referred to some vague 'Hygiene Principles' without prescribing the minimum or maximum required levels of noise, illumination, temperature and humidity. It was open to a wide range of interpretations and left its application to the good will of the employers. As it was combined with an inadequate inspection system, it proved in practice to be quite ineffective.

The Decree had some implications for design although they were limited and superficial. The article which referred to natural ventilation made compulsory the provision of a certain amount of air per worker (at least 8m³) and had an impact on the volume of the building. Furthermore, the sanitary regulations imposed similar changes since they introduced a number of spaces which were rarely provided before such as toilets, cloakrooms, refectories and rest rooms. Details were also given about the number of toilets, basins and their spatial organization.

In the same period another Decree³³ was prescribed which did have a fundamental effect on the design of factories. It referred to the required licenses that an industrial firm had to have been granted in order to develop its industrial premises. There were three kinds of licenses 'the establishment license', 'the operation license', and 'the construction license', and these were all obtained from the Ministry of Transport. This Decree can be considered as the first measure taken by the State to control industrial development and to ensure the viability and efficiency of newly established plants. The most important requirement of that Decree was the submission of complete architectural drawings and structural analysis, as one of the necessary preconditions for the approval of the application. Although the drawings were to be signed by the land owner, the employment of licensed engineers was necessary since the requirements of the drawings were advanced and needed detailed elaboration.

This particular statutory measure marked the beginning of the compulsory involvement in the design of factories, of architects and engineers whose skills were moulded through a university system of education. Before that industrial buildings had been put up by traditional builders supervised by a master-mason. There is no particular written evidence that before the prescription of this Royal Decree master-masons provided complete drawings for the erection of buildings apart from rough sketches to assist their workmen in their progress.

The same Decree imposed conditions concerning the buildings, the steam engines, the transmission machinery, drainage, ventilation, natural and artificial lighting, and electrical installations. Prescriptions had a summary character and were far from adequate enough to develop a healthy and safe environment; furthermore, they were not influential on factory design.

From the mid 30's until the beginning of the 70's very few statutory measures were taken mainly concerning particular sectors such as the steel, tanning and printing industries and also those whose products contained lead, benzol and other toxic substances. This situation had resulted from two factors. On the one hand, governments were always reluctant in prescribing laws and controls since they were susceptible to pressures from industrialists. On the other hand, the labour movement was largely orientated towards general aims such as the increase of wages and trade union freedoms³⁴.

After 1976 a number of decrees were passed introducing issues related to health and safety at work. These are on fire prevention (P.D. 460/1976, D.38901/1976, D.380202/1976, L. 616/1977, D.17483/1978 and D.17484/1978), on air and noise pollution (D. 11942/518/1980), on waste disposal, and on thermal insulation of buildings.

Fire prevention legislation is an important element in design and usually has an influence on the articulation of spaces, the structural system, and the choice of building materials.

Relevant Greek statutory measures, on the contrary, have a rather insubstantial impact on factory design since the decrees on fire prevention refer mainly to the fire-fighting equipment rather than to compartmentation, structural protection, venting and methods of preventing fire spread. In 1981 a detailed addition to Law 616/1977 determined, in a complete and detailed way, the necessary fire measures for large halls covering such issues as fire prevention, detection and alarms, fire control systems, structural protection and compartmentation. But they are compulsory only in theatres, cinemas, restaurants, exhibition halls, courts and other public spaces, and nothing is mentioned about factories.

Finally, the legislation on air and noise pollution as well as on waste disposal and thermal insulation, though general and inadequate, have a potential influence on the choice of the site, the location of the building, its kind of openings, the choice of materials for constructions and the elaboration of its details.

Very recently a new law (L 1568/18.10.85) passed out under the general spirit of improving occupational health and safety. The Law sets up a number of bodies both at the National and Local level as well as at the level of the plant. Their task is generally accident prevention and industrial hygiene. Furthermore, it introduces a number of regulations which are largely general and open to wide interpretations. These are related to the conditions on the working premises, the prevention of hazards from the machines and the workers.

protection from chemical and biological factors. The Law is very general and can only be regarded as a basis on which other laws more specific and detailed should be developed related to each branch of industry. Thus, it is very difficult to foresee the influence of this Law as it is, on factory designing in general and textiles in particular.

2.4. BUILDING MATERIALS

When the first factories were erected in Greece at the end of the nineteenth century, they were made using traditional methods and materials. All building construction was of simple load bearing stone or brick walls with timber or iron inner columns and beams. Floors were wooden as were the roofs which were covered with clay tiles. Timber and iron columns were often imported from abroad as can be seen in a Commercial Bulletin of 1908³⁵ referring to prices of building materials that could be found in the market of Athens and Piraeus, and also in advertisements by commercial firms for steel and cast-iron columns imported from Europe³⁶.

Reinforced concrete was employed by Greek engineers from the very beginning of the century. The first cement factory was established in 1902 in Elefsina - nowadays the biggest centre of heavy industry in Greece - with 70-80 workers and production at 6,000 tons per year³⁷. The first seminal experiment in reinforced concrete was a four storey hotel (fig. 28 and fig. 29) of 952 square meters in the centre of



Fig.28. Building of A. Afentouli. It is still in use today. Its formal language does not reveal the revolutionary use of material and the building looks like any other building of its period ³⁸

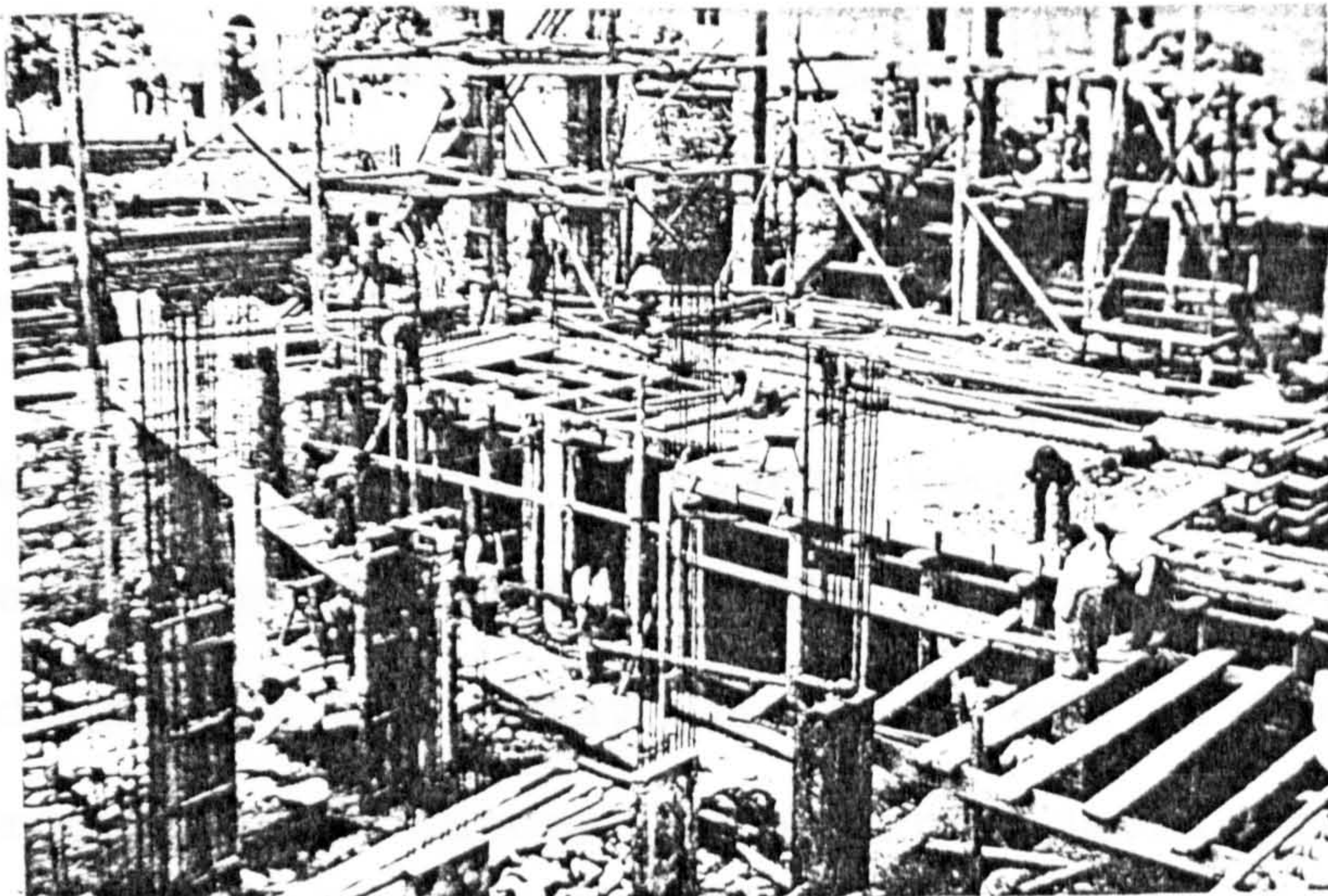


Fig.29. Building of A. Afentouli. View during the period of its construction ³⁹

Athens opposite the old parliament building. According to the engineer I. Angelopoulos⁴⁰ who advocated the idea of reinforced concrete and supervised the construction, the structural analysis had been made in France by the Hennebique company.

In one of his articles written in 'Archimidis', Angelopoulos referred to some of his previous works - warehouse, water-tower, bridges - where he had successfully used reinforced concrete, and he supported the idea that the new building material had its own beauty that should be exposed⁴¹.

From that period onwards reinforced concrete rapidly became the main material for load-bearing skeleton frames. A number of articles written by civil engineers presented the various methods of structural design of reinforced concrete⁴².

Furthermore, structural design in concrete was introduced as a course for civil engineers in the Technical University of Athens in 1916.⁴³

Reinforced concrete soon displaced wood and iron as load bearing elements of buildings. The production of cement developed rapidly and today Greece is one of the largest cement producers of Europe. This rapid development occurred mainly after the beginning of the '50's when an extraordinary boom took place in the construction industry.

The principal impetus in construction activity has been the post-War effort to reconstruct the devastated areas of the country. However, the boom that followed was the result of a number of coexisting physical, economic, demographic,

sociological, psychological and political factors⁴⁴. The most important were the internal emigration from the countryside to Athens, the trend of Greeks to invest in sites and buildings due to the minimal risk involved and the instability of their savings, the small import content of house construction since most of the building materials were produced within the country, and finally and most importantly the government policy which encouraged the construction industry in order to solve the problem of increasing unemployment.

After the middle 60's and the second construction boom, a number of new building materials were introduced in the construction industry. The majority of the materials were produced in Greece, but often such as some wood products, steel, artificial materials and a few paints were imported. The introduction of a variety of foreign materials in the Greek market caused problems in the absence of appropriate techniques and methods of construction⁴⁵.

The architect S. Kontaratos referred to this disproportionate development of materials and techniques

early in 1974 when he pointed out that "... in countries like ours where the mechanization and the systematic organization of labour have not as yet been developed adequately, the transfer of modern technology and building materials creates particular difficulties in building construction, as it comes into conflict with old techniques and customs which still exist to a great extent. The result is often a substantial loss in quality of the modern as well as the traditional elements of construction"⁴⁶.

At the end of the 60's the idea of introducing prefabrication in Greece was advocated by the majority of engineers despite the fact that some of the characteristics

of the construction industry in Greece did not lean in this direction. These features were the small size of construction works and the surplus of labour which was mainly unskilled⁴⁷. In 1969 a special course on prefabrication was introduced in the Civil Engineering department of the Technical University of Athens.⁴⁸ Though the outlook for a solution to these problems was promising, prefabrication was not used to any great extent in the Greek construction industry. This is mirrored in the fact that only three buildings (A.43, A.49 and A.50) out of the fifty seven of the survey of the thesis are made of prefabricated reinforced concrete elements.

Finally, during the last decade a reintroduction of steel as a building material has taken place. It is mainly used in columns and roof trusses for large spans in factories, warehouses, exhibition halls and hangars.

CHAPTER 3

THE SURVEY

INTRODUCTION

This chapter discusses the survey component of the thesis and is mainly descriptive in character. In other words, it is mainly concerned with 'how the mill buildings are' rather than with 'why they are like that' and deals with their historical origin and evolution.

The focus is more on buildings than on architects or architectural stylistic movements. This distinguishes the approach of the thesis (as has been discussed in the general introduction) from the traditional outlook on historical issues in architecture since most historical studies have focused on architects or styles and deal with certain building classes (mainly houses and public buildings) and a selected number of masterpieces, which are only a small proportion of the total built environment.

The survey is based on a sample of 57 factories which have been chosen to be representative of the entire stock. A necessary prerequisite for the inclusion of a building in the sample is the existence of a complete set of its drawings (site plan, plans, sections, elevations).

The conditions under which the survey has taken place are described in the first section (3.1) of the chapter together with the characteristics of the sample and the criteria of its formation. The second section (3.2), the backbone of the chapter, describes the evolution of mills from the end of the nineteenth century to the present, in terms of their formal language, constructional system and articulation of space.

The formal language deals with the formal elements of buildings and the way they are assembled to express the designer's conceptual idea and fulfill functional requirements. More analytically, it refers to the kinds of spatial volume or volumes, their geometrical or topological organization, the form of the roof, the size and kind of openings, illumination, colours, textures, and external decorative elements. The structural system is related to the kind and form of the construction and building materials. The articulation of spaces deals with the way interior spaces are linked together; it corresponds to certain spatial relations determined more by the production process than by social purposes and patterns.

The chapter closes with a section (3.3) which seeks to criticize the descriptive analysis. Apart from the positive characteristics of the analysis, it reveals the problem which is created by the large number of descriptive data and the fragmented approach this form of analysis necessarily introduces. Furthermore, this concluding section introduces the intention of examining the utility of a typological approach for the comprehensive analysis of the case study material.

3.1. CONDITIONS OF THE FIELD WORK - CHARACTERISTICS OF THE SAMPLE

The survey in general and the formation of the sample in particular are conditioned by the fact that the necessary material has not been published. There are three main sources from which the information for the survey is drawn. The first is 'The Financial Directory of Greek Companies'¹ which includes the names of PLC and LTD firms, the year of their establishment, their address, their location, the number of their employees, and some of the financial data included in their balance sheets of 1980 and 1981. The second and most important source of information is the records of the Department of Industry. Every firm in Greece is required by law to obtain planning permission from the Department of Industry in order to build a new building, to expand or renew its existing industrial premises. For this purpose, it has to submit a complete set of drawings of its buildings, apart from the elevations, indicating the position of machines, their type and their installed mechanical power. The absence of elevations has obliged me to visit all the buildings of the sample. These visits constitute the third and fundamental source of my information since they have provided me with important additional knowledge concerning the buildings, the way they operate, their atmosphere and the surrounding area.

The formation of the sample is influenced by the fact that the only known source of information for the drawings of the buildings was the Department of Industry. Thus, the

sample includes buildings belonging to PLC and LTD firms which have machines with more than 500 Hp, since only these are included in the records of the Department of Industry. These firms represent 39% of the total of the sector in terms of absolute numbers, 90% in terms of the total horse power of their machines and 59% in terms of employment. Fig. 30 shows the relationship between the numbers of firms (F) and buildings (B) in the textile industries in general and in spinning and weaving industries in particular, and gives the figures for the sample.

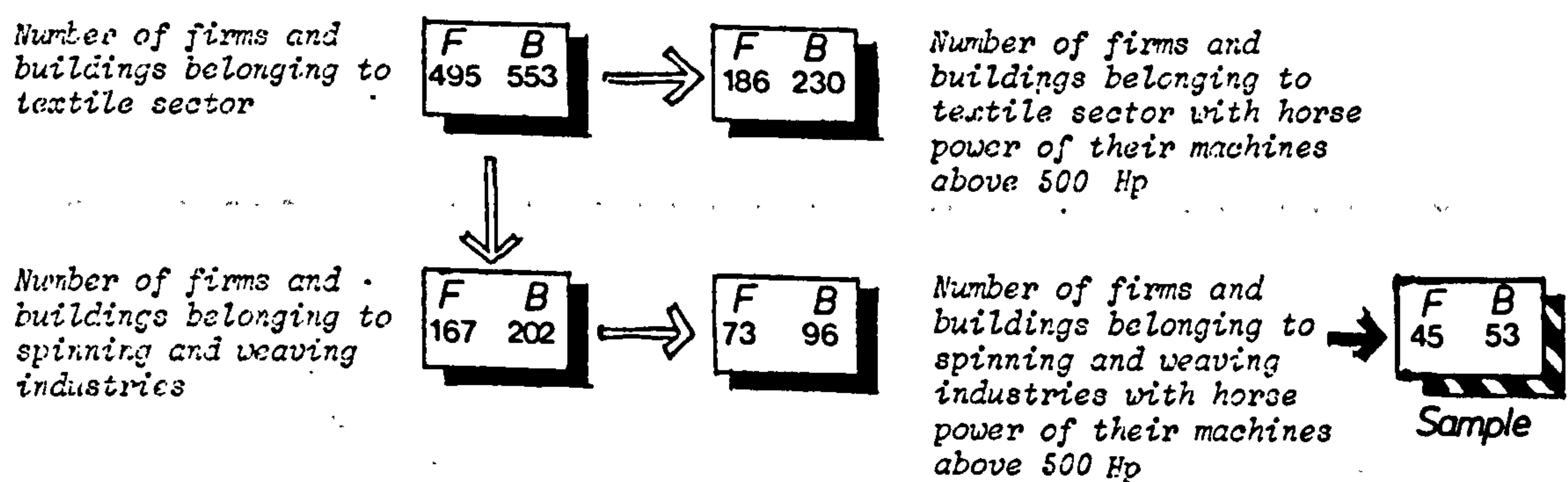


Fig. 30

The sample has been chosen using three major criteria. The first is the year of the construction of the building which in most cases coincides more or less with the year of establishment of the firm. The second is the location of the building within the country. The third is the size of the firm in terms of the number of employees, the horse power of its machines and its total assets.

Some inherent difficulties have affected the final choice of the buildings of the sample. These are related to the inaccessible location of some of the factories and to the

suspicious attitude of some of the owners of the firms who have refused to give permission to visit their premises. Finally, information is used concerning buildings which are not included in the sample. This information is not complete, since it is based only on photographs of their facades. Nevertheless, it provides useful additional evidence.

The following four tables (Table 16, 17, 18 and 19) and two figures (fig. 31 and 32) aim to provide the comparative features between the buildings belonging to the spinning and weaving industries with machine power above 500 Hp and those belonging to the sample, according to the above three criteria.

TABLE 16

Year of Number of buildings establ	end of nineteenth-1940 century	1940 - 1960	1960 - 1980
TOTAL	27	20	49
SAMPLE	21	8	28

TABLE 17

employees Number of buildings	-100	100-200	200-300	300-400	400+
TOTAL	19	25	23	12	18
SAMPLE	5	14	17	8	10

TABLE 18

horse Number of buildings power	500-2.000	2.000-4.000	4.000-6.000	6.000+
TOTAL	51	31	10	4
SAMPLE	24	18	4	3

TABLE 19

<div>total assets (drs)</div> <div>Number of buildings</div>	100.000 - 400.000	400.000 - 800.000	800.000 - 1.200.000	1.200.000+
TOTAL	35	16	7	14
SAMPLE	19	8	5	12

Source: Extracted from ICAP, 'Financial Directory of Greek Companies', Athens, 1982, and personal communication with the firms.

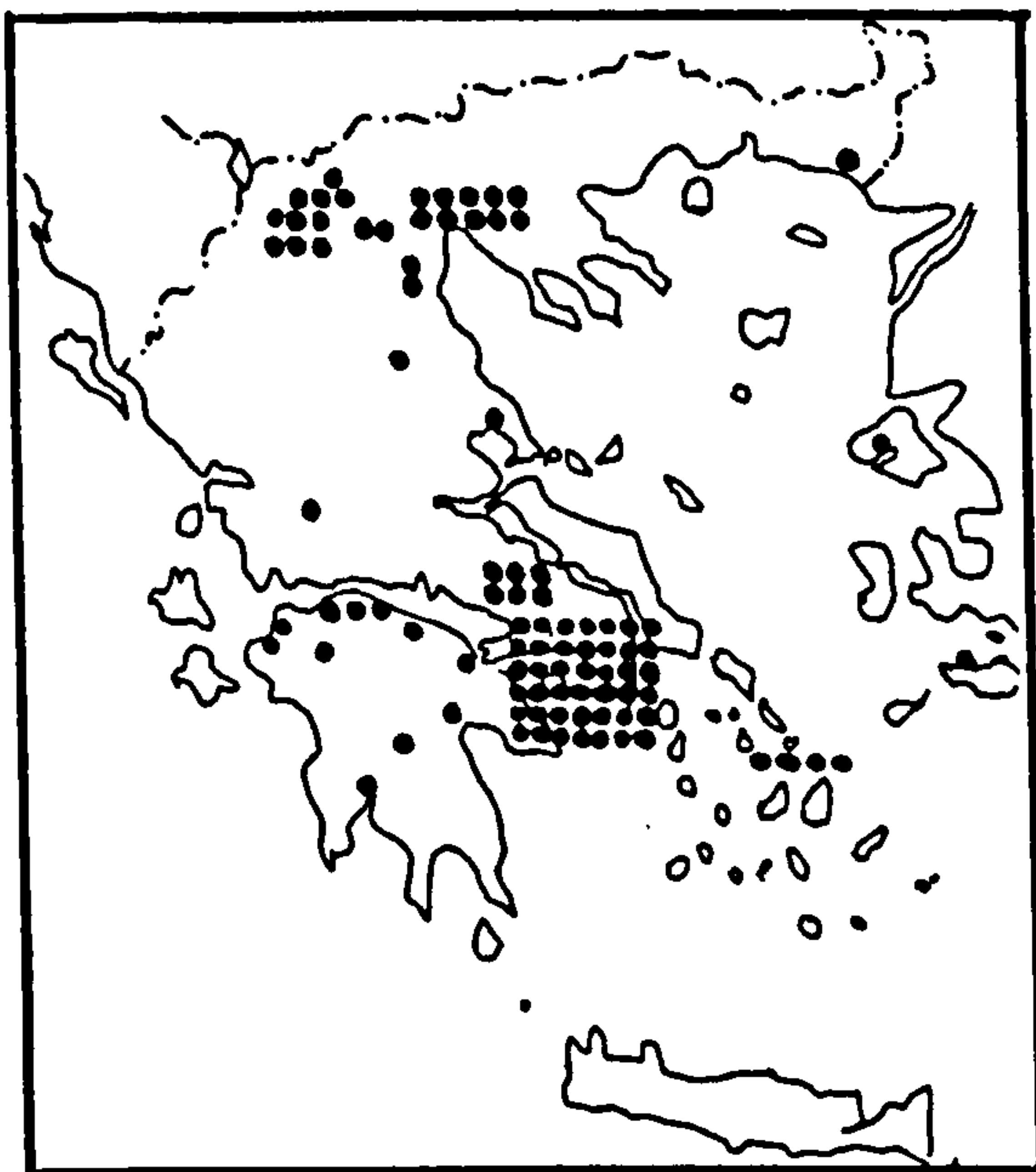


Fig.31.Distribution of spinning and weaving industries in Greece



Fig.32.Distribution of the buildings of the sample in Greece

Finally, four buildings are included in the sample (A.2, A.3, A.7, A.16) which are not in use now, but used to belong to three firms which flourished before World War One.

3.2. THE DESCRIPTION OF THE EVOLUTION OF MILLS

Formal Language

The architecture of mills in Greece has undergone many changes

since the first factory was established in Piraeus by RETSINAS firm (A.1) in 1872² until today. The early mills, at the end of the nineteenth century, are either very simple, usually single-storey buildings characterized by their gabled roofs (fig. 33-39 and A2,A3,A4), or complexes with combinations of gabled and saw tooth roofs (fig. 40, 41 and A.1) The external unembellished surface of the buildings, usually plastered with white stucco, is interrupted only by the strict sequence of rectangular or arched windows.

Around the turn of the century the formal language of mills gradually becomes more elaborate and is enriched with regional characteristics which in some cases, as in the island of Syros, are very particular and specific⁵. Typical characteristics of the mills of Syros are the sequence of gable roofs (A.5, A.8 and fig. 42) with pedimental treatment on the facade, the round or arched window in the centre of the pediment and the bipartite or tripartite articulation of the facades (fig. 42-45 and A.5, A.8). The amalgamation of classical elements (pediment, tripartite articulation) with traditional features (openings, the emphasized outlines of buildings, the treatment of walling) is the distinctive characteristic of the mills of the island. This fusion is derived from the twofold architecture - traditional and neoclassical - of the capital of the island.

The architecture of Ano Syros - the upper and oldest part of the settlement lying at the top of the hill (fig. 46) - is distinguished by its traditional architecture. The houses, like small cubic volumes with flat roofs and small openings,



Fig.33. View from the road of 'Spinning and Weaving Mills of Edessa' (A.4), between 1884 and 1912, (Edessa)

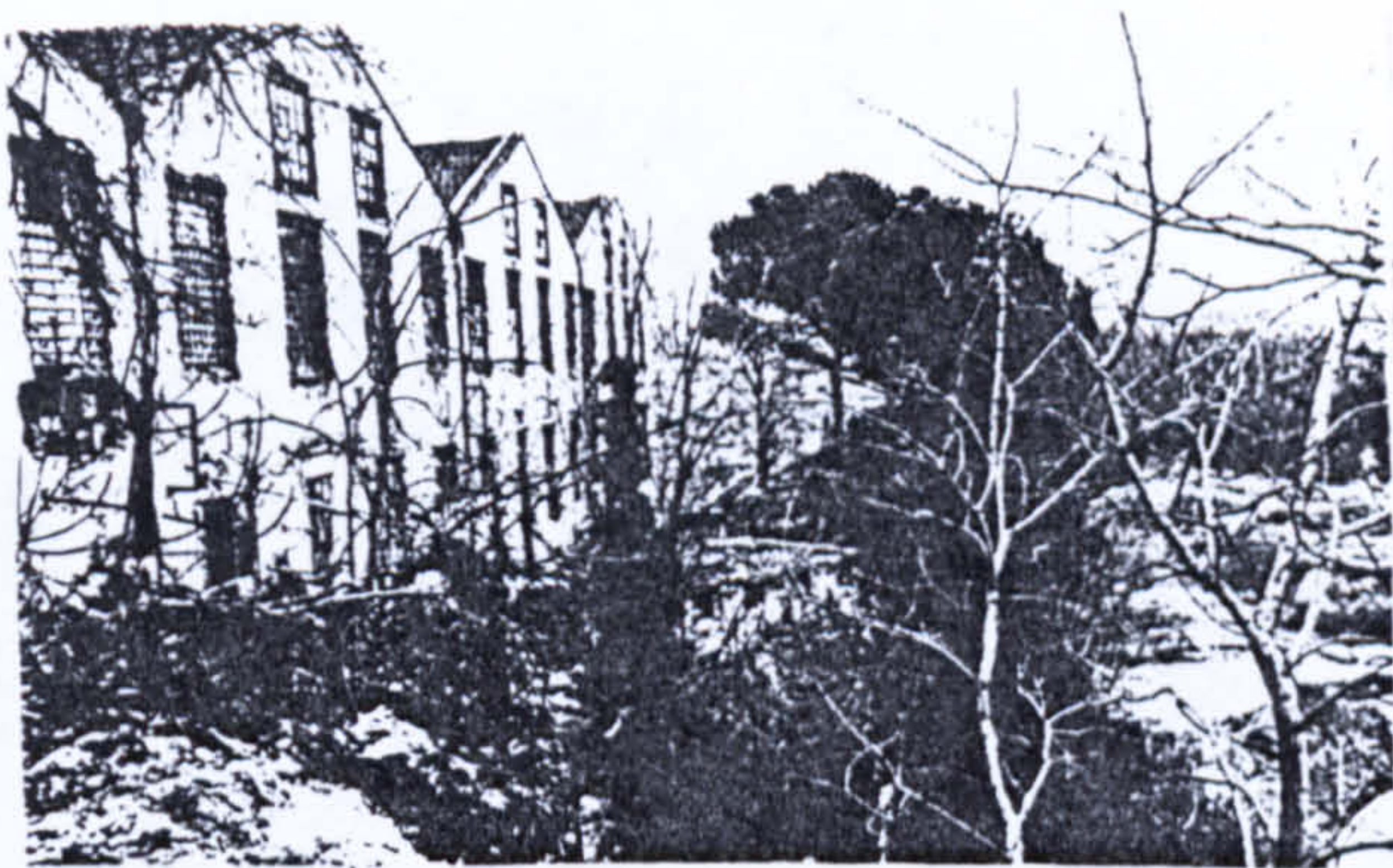


Fig.34. View from the waterfalls of 'Spinning and Weaving Mills of Edessa', (A.4), between 1884 and 1912, (Edessa)



Fig.35. 'K. and A. Drakopoulos, Weaving Mill', (A.2). One of the rare early examples distinguished for its rich formal language (variety of openings, classical pediment treatment of the main facade, details, motives) in comparison to the simple and plain language of the other mills of the country. It was originally named 'S. Vezanis & Selas' mill, 1882, (Athens)



Fig.36. 'K. and A. Drakopoulos, Weaving Mill', (A.2). The neoclassical office building constructed in front of the main facade of the mill and the other two villas, at the background constructed at the beginning of 20's, make the complex the only one remaining in Greece today which combined production, administrative and residential activities. It has not been in use from 1956, (Athens)

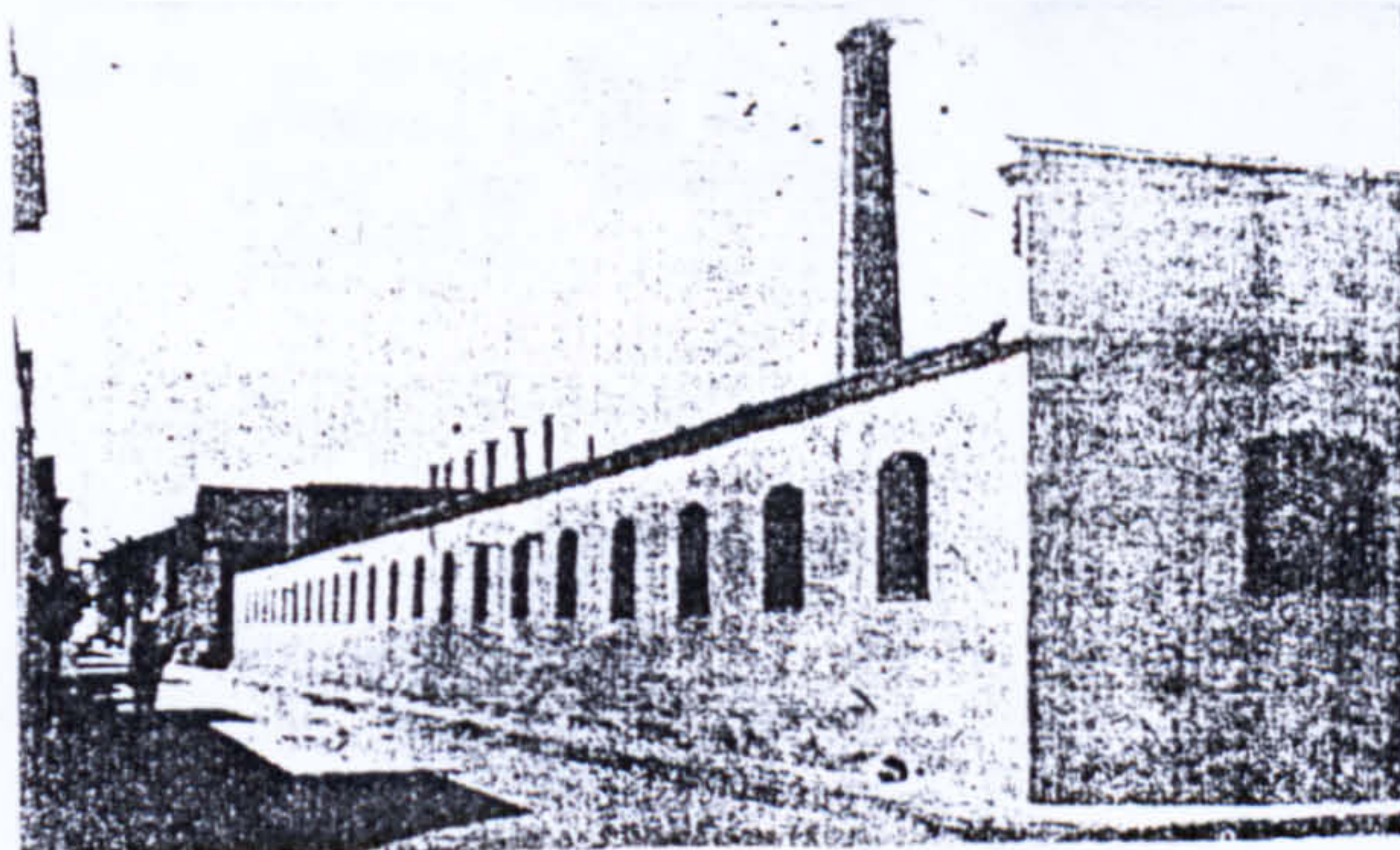


Fig.37. 'Pierrakos Textile' mill (A.3). It has been demolished. It was originally named 'E. Torres & Co' mill, 1886, (Thessaloniki)³



Fig.38. 'Politis' mill. It is now used as machine shop, Between 1907 and 1916 (Piraeus)



Fig.39. A mill constructed before 1910 in Edessa. It has not been in use for many years



Fig.40. 'Tsitsis & Sons' mill. The buildings have been demolished, between 1884 and 1900, (Edessa)⁴

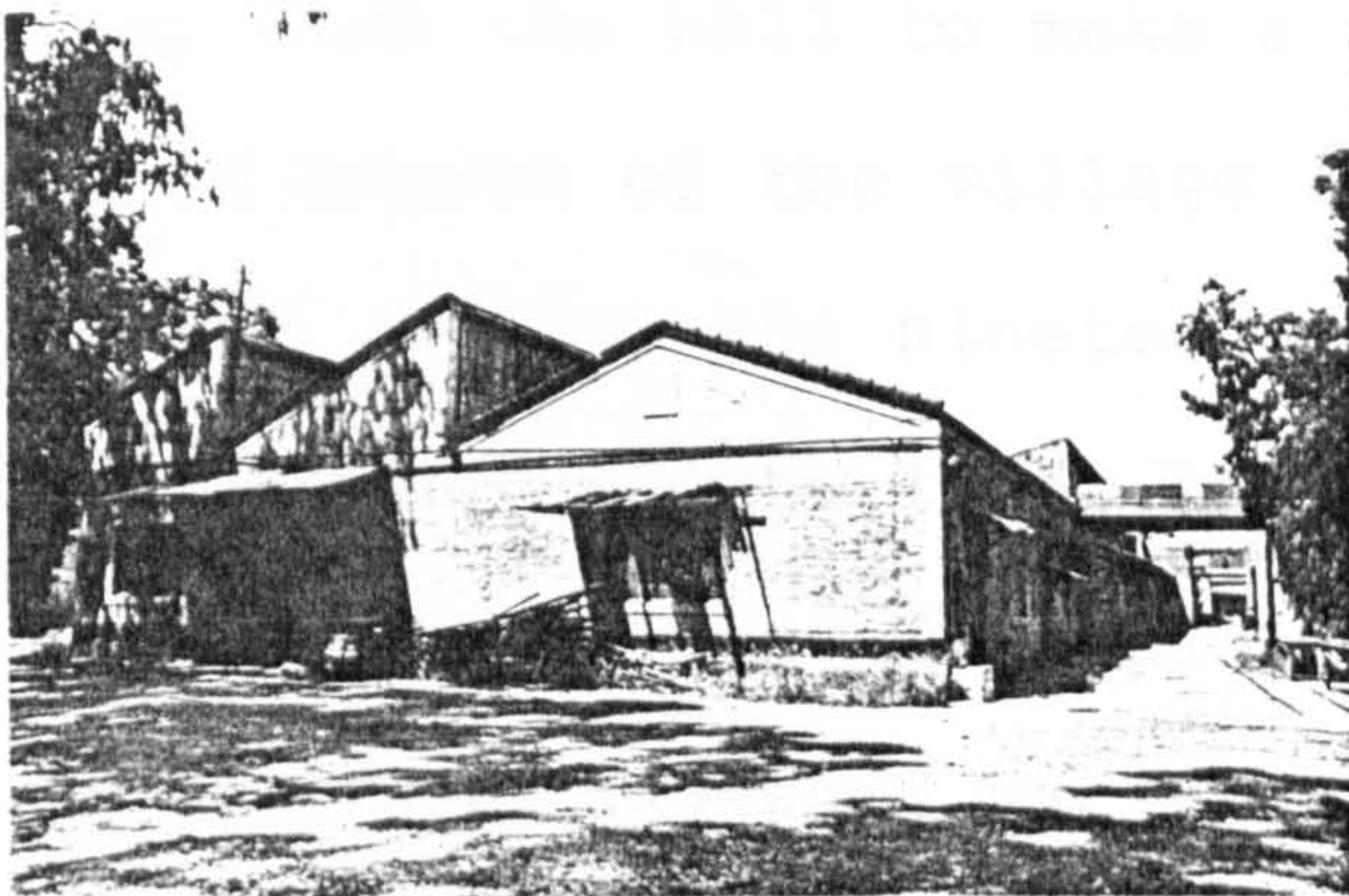


Fig. 41. 'Retsina Bros, Spinning & Weaving Co' mill (A.1), 1872, (Piraeus)



Fig. 42. A sequence of mills in Ermoupolis, (Syros),

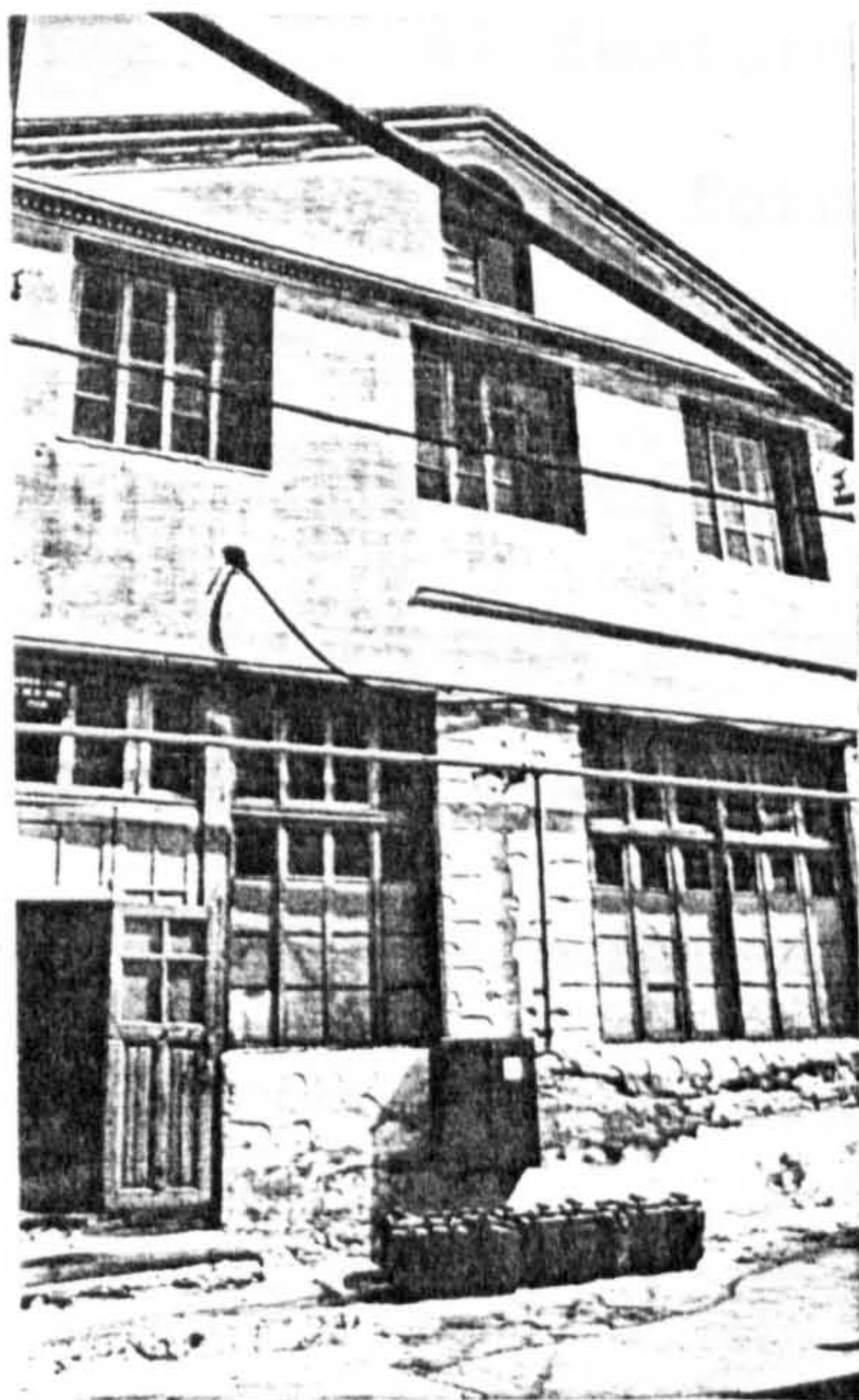


Fig. 43. 'Barbetas' mill (A.8). Entrance to the shop-floor, Beg. 20's-1936, (Syros)



Fig. 44. 'Barbetas' mill (A.8). View from the courtyard, (Syros)

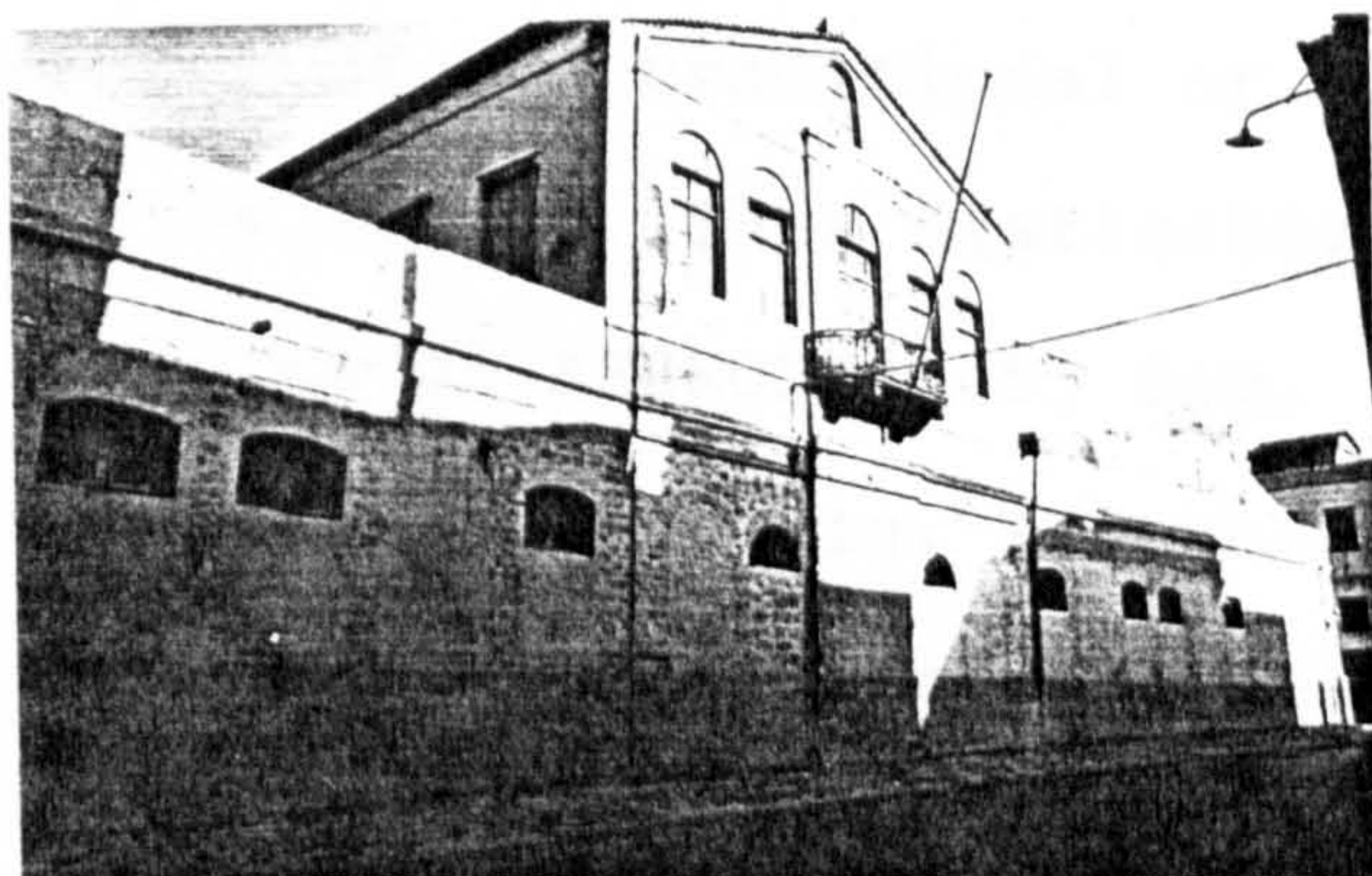


Fig. 45. 'Aegeon Mills' (A.5). View from the road. The old construction of the ground floor and the windows which have been blocked in can hardly be seen, 1887, (Syros)

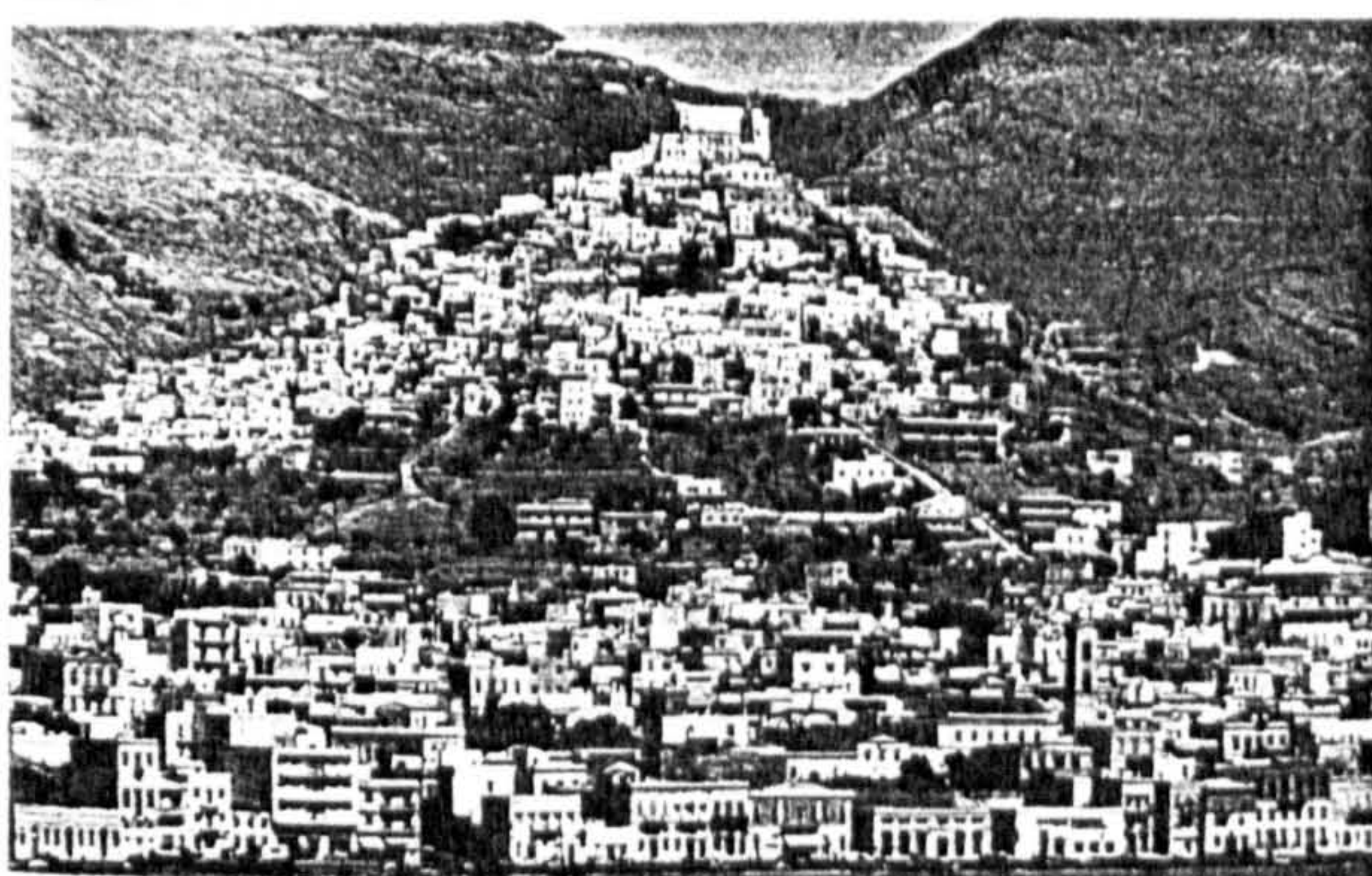


Fig. 46. View of the capital of Syros⁶

step down the hill to make a perfect defensive system. The rapid growth of the village into an industrial and mercantile centre during the nineteenth century brings about the development of the lower part of the settlement - the so called Ermoupolis. This part stretches along the seashore and is distinguished by its neoclassical architecture. The mills which are part of this recently developed city have been affected more by neoclassical elements than by the traditional features of the old town. However, the pediment as part of the formal vocabulary is not very common in the buildings of the town. Thus, the gabled roof of the mills, as a manifestation of the need to cover large spans, gives the buildings a character similar to that of the traditional houses of Simi (fig. 47), which is another Aegean island having a consistently neoclassical architecture. A recent addition to the SYROS SPINNING MILLS (A.21) tries to maintain the same principles using a modern vocabulary (fig. 48, 49).

The patterns of windows which have been used in the mills of the island are illustrated in fig. 50. Window C is not typical either of the traditional or the neoclassical architecture of the island. This distinctive pattern appears only in the building of AEGEON (A.5, fig. 45) and in one neoclassical house of Athens (fig. 51), which is included in a photographic collection of approximately 190 buildings, published in the book 'The Neoclassical Buildings of Athens and Piraeus'⁸. The two buildings not only share the same kind of windows but also appear to be quite identical (compare fig. 45 and 51).



Fig.47. Three family houses by the old harbour, c 1900s, (Simi) ⁷



Fig.48. 'Syros Spinning Mills' (A.21). View of the recently constructed part of the mill, early 70's, (Syros)

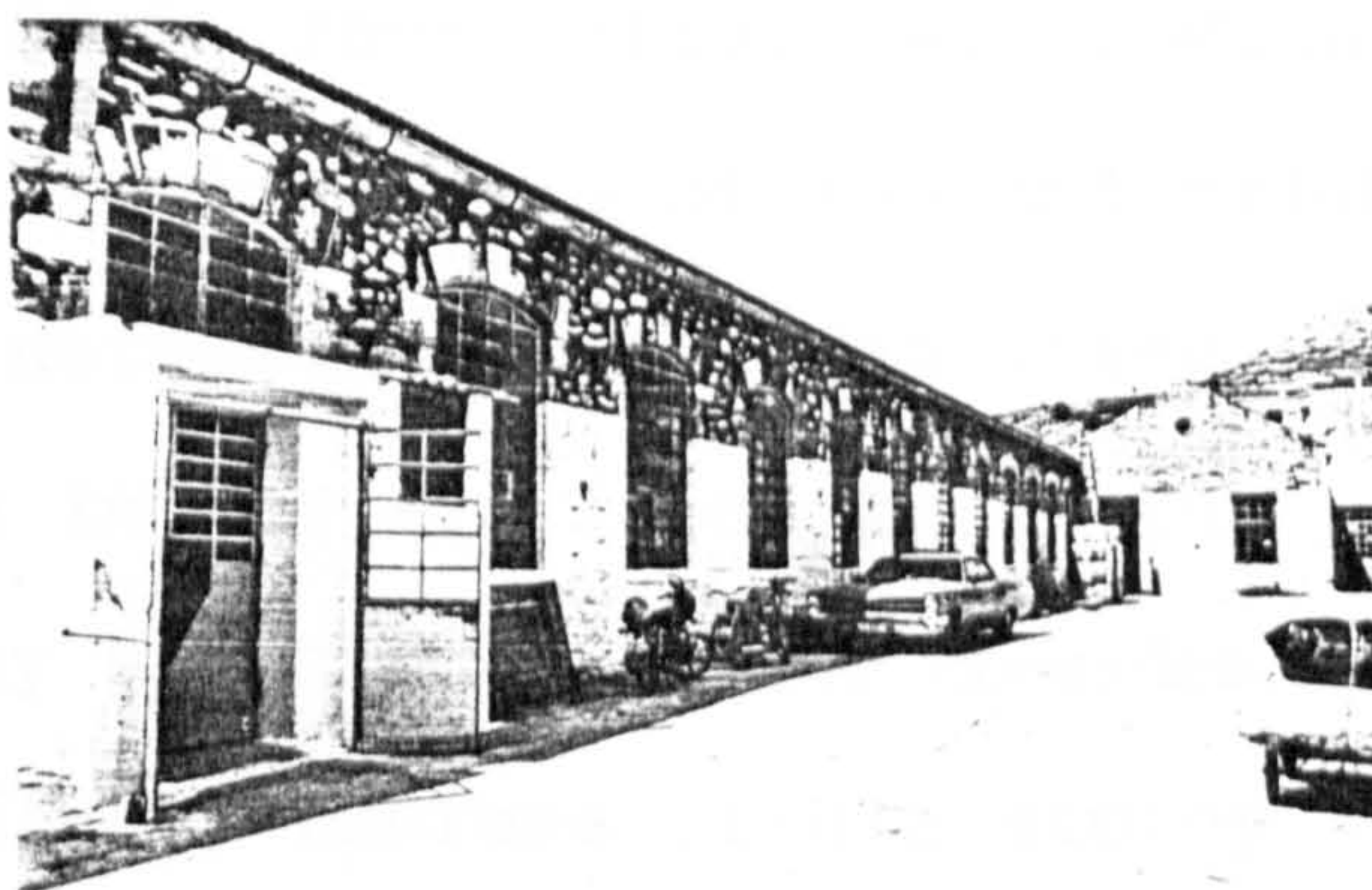


Fig.49. 'Syros Spinning Mill' (A.21). View of the old mill behind the addition, 1890's, (Syros)

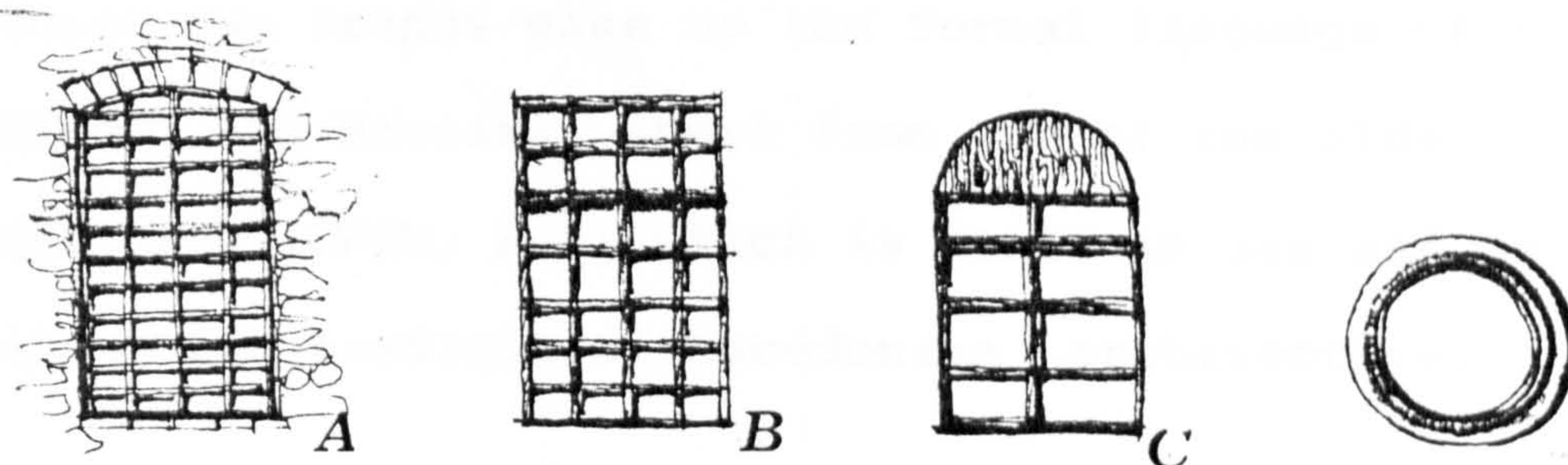


Fig.50. Patterns of windows. C and D are mainly used in the first floor and the pediment



Fig.51. Neoclassical house in Athens

The mills in the area of Edessa and Naoussa are distinguished by two main characteristics: the influence of European industrial architecture of the nineteenth and early twentieth centuries on the formal language of the main production hall and the particular emphasis on the administration quarters of the mill. The multi-storey rectangular blocks with the pitched or saw tooth roof (fig. 52,53) and the single or double-storey buildings with northern light roofs (fig. 54,55), which have been the favourite industrial architecture of the industrialized countries at the end of nineteenth and the beginning of the twentieth century, are shown in the architecture of the mills of the area. Multi-storey buildings have been considered appropriate for large textile firms, whereas single storey buildings have been preferred by small firms (fig. 56-60).

These two trends make up the formal language of the mills of Edessa and Naoussa, apart from one of the oldest mills of the area (IFEN, A.6) which is still in use and is distinguished by its traditional Macedonian architecture.

The simple geometrical facades of the mills are interrupted by the orderly sequence of windows, which are basically of the same pattern (fig. 61): the vertically or horizontally rectangular shape with or without arches. There is usually an architrave of stone or brick which emphasizes the shape of the window. A false keystone or brick is built in the centre of the arch showing a faithful imitation of classical precedent.

The architectural character of the administration quarters

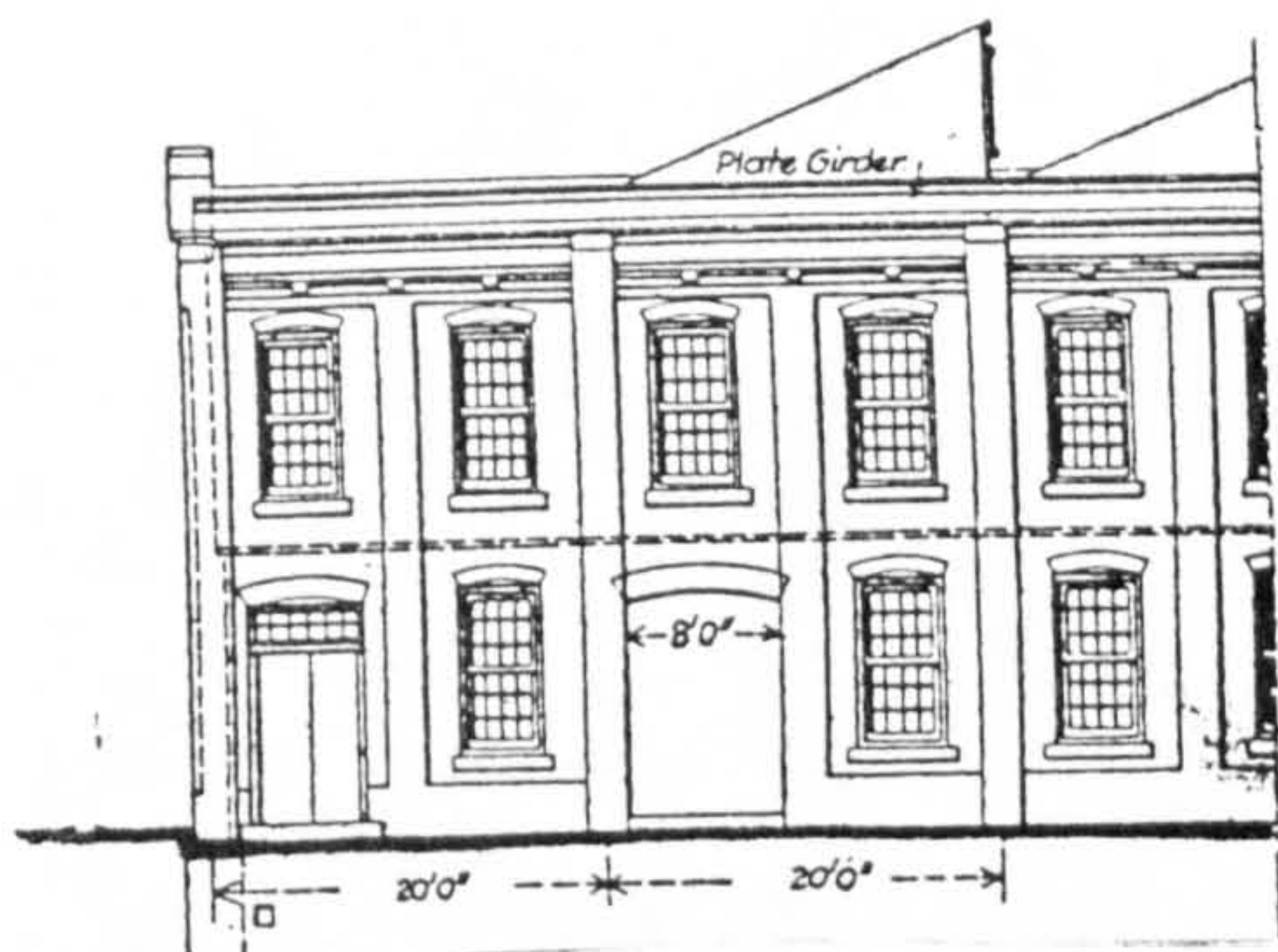


Fig. 52. View of a factory from the advertising leaflet of the company (Bibliothèque Municipale de Lille)⁹



Fig. 53. Part of the front elevation of a building presented in a treatise on mill building construction which was written at the beginning of the twentieth century¹⁰

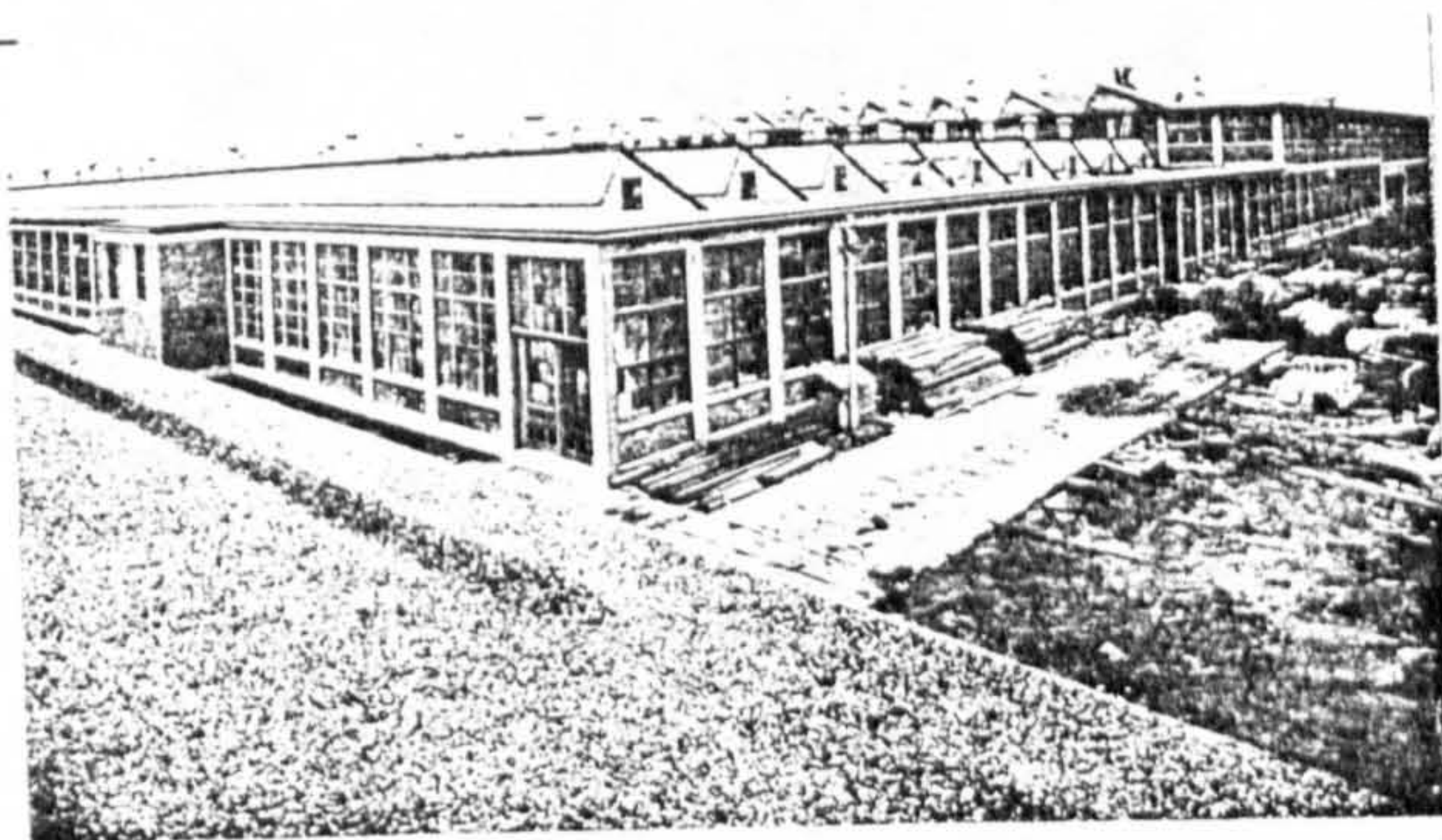


Fig. 54. One of Packard's plants designed by A. Kahn in 1906. It was the first plant which introduced the single storey, roof lighted factory into automobile factory design¹¹

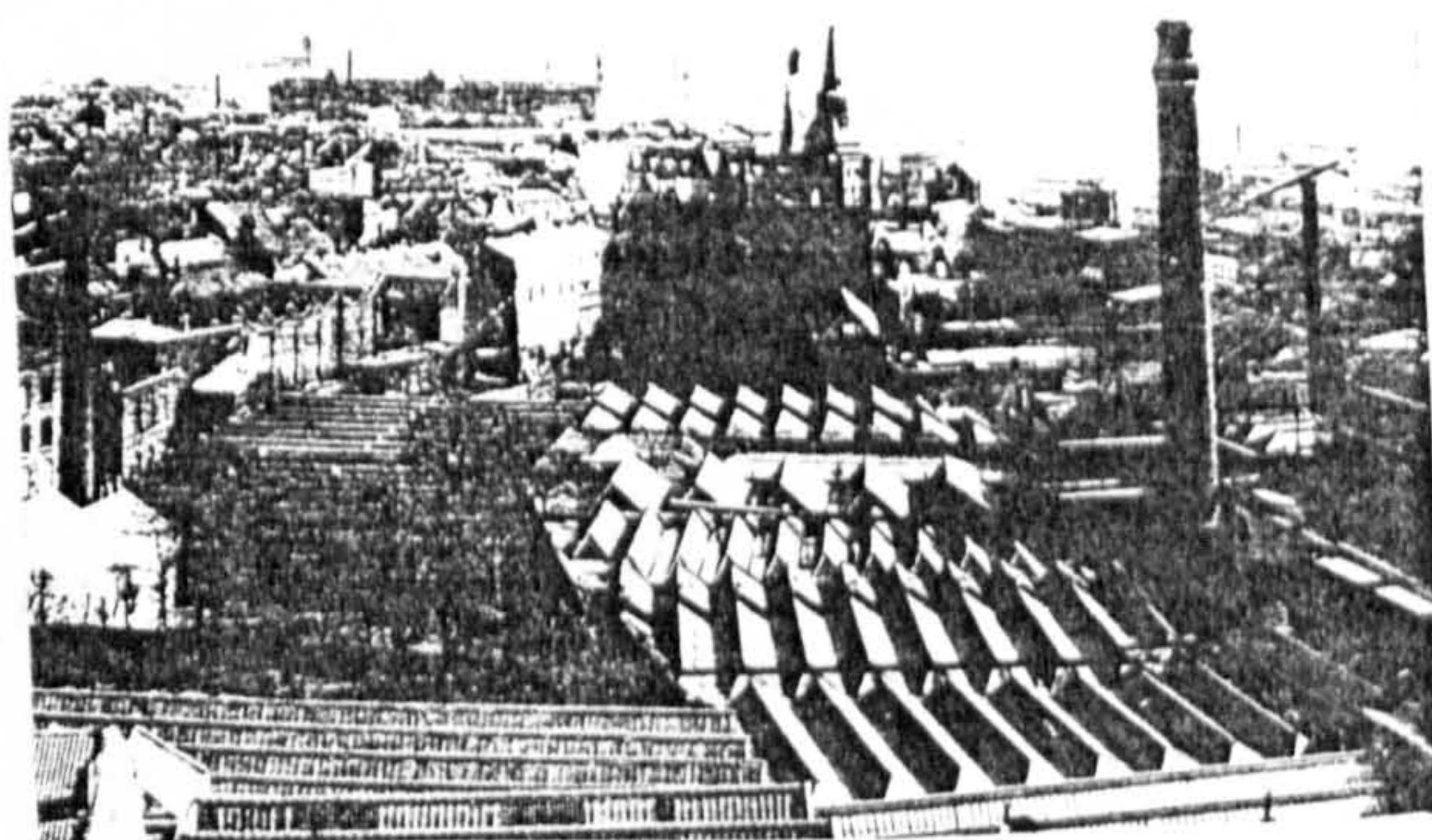


Fig. 55. View of the centre of Roubaix around 1900 (Caisse Nationale des Monuments Historiques).¹²



Fig. 56. 'Pella-Olympos Maced. Spinning & Weaving Mills' (A.10). View of the building used for weaving. The saw tooth roof is not visible because it covers only the central span and is hidden behind a high parapet running along the top of the building, before 1920, (Naoussa)

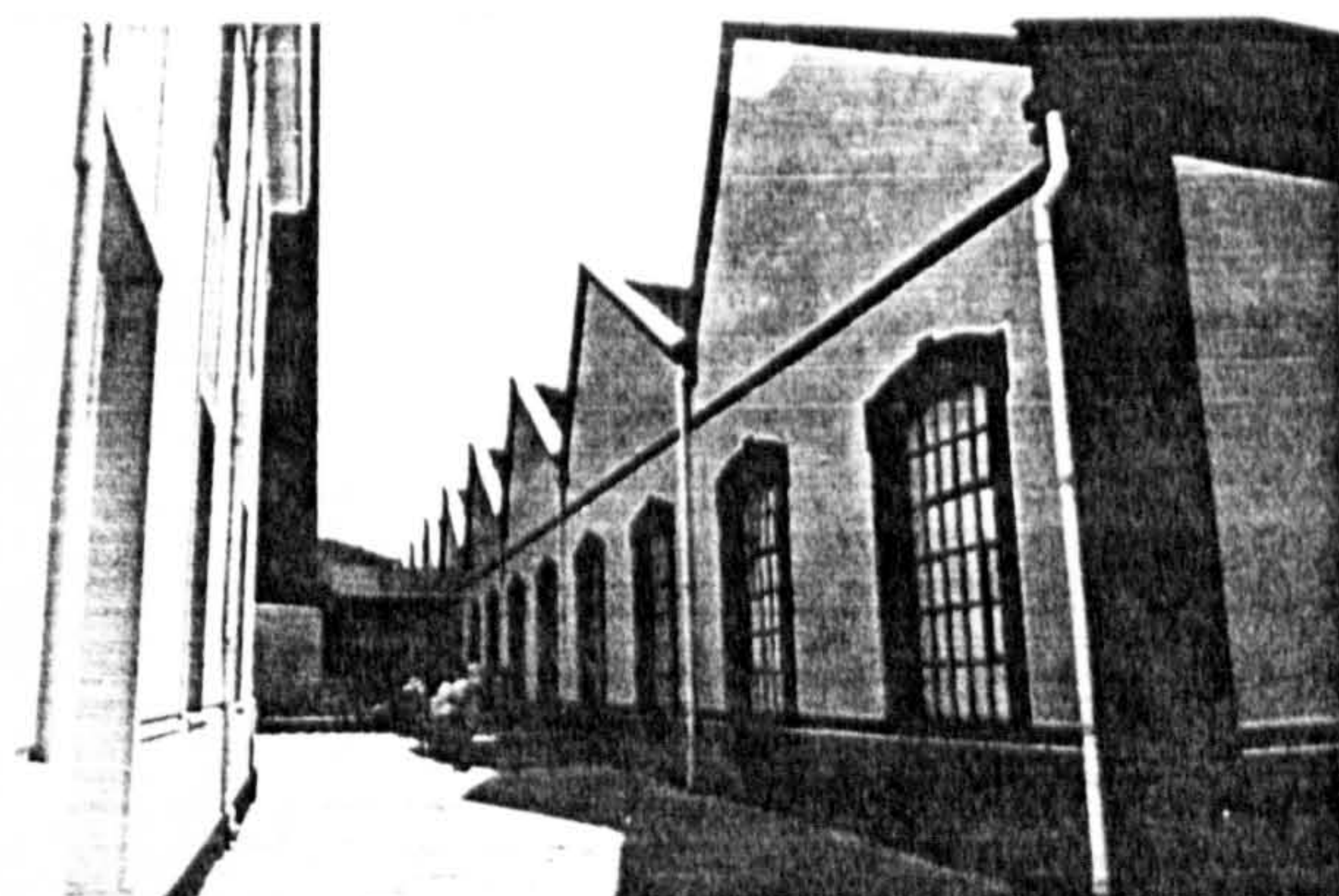


Fig. 57. 'Pella-Olympos Maced. Spinning & Weaving Mills' (A.10). View of the building used for spinning, before 1920, (Naoussa)

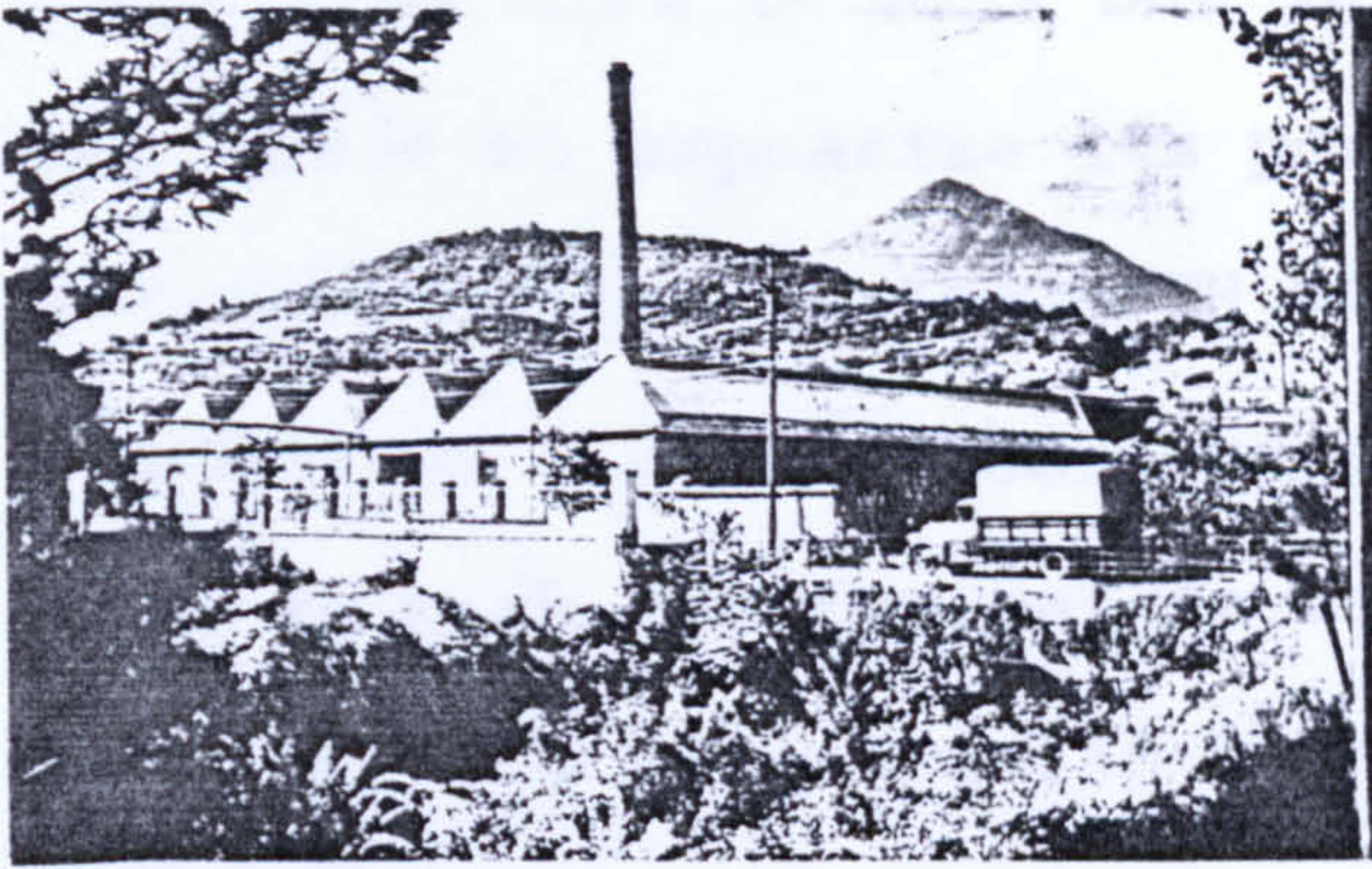


Fig.58. 'Vetlans Naoussa Spinning & Weaving Mills' (A.52). The old building which has been demolished, 1922, (Naoussa)



Fig.59. 'Naoussa Spinning Mills' (A.9), c.a. 1928, (Naoussa)

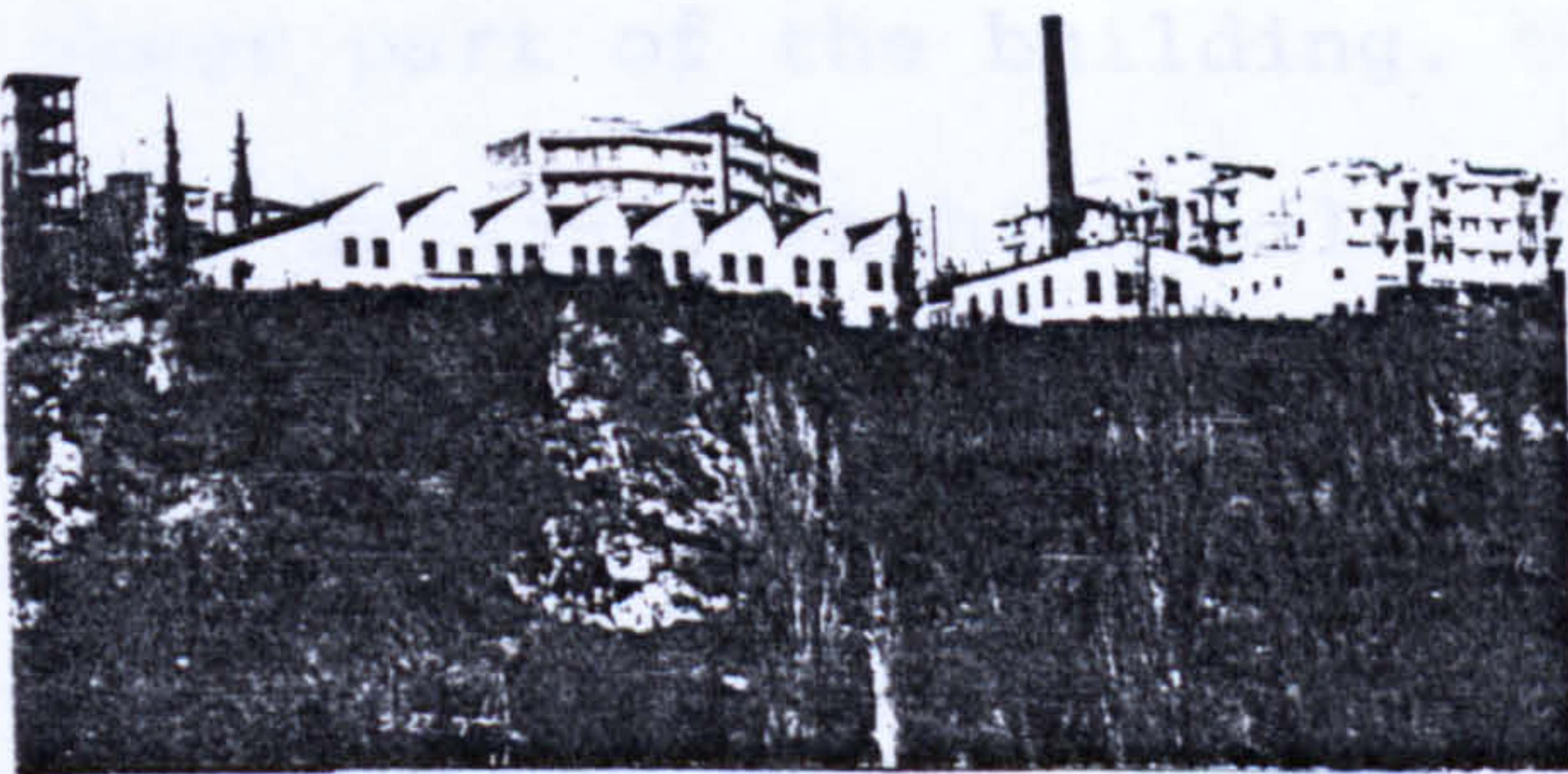


Fig.60. 'Sefeco Wool Industry', 1930's, (Edessa)

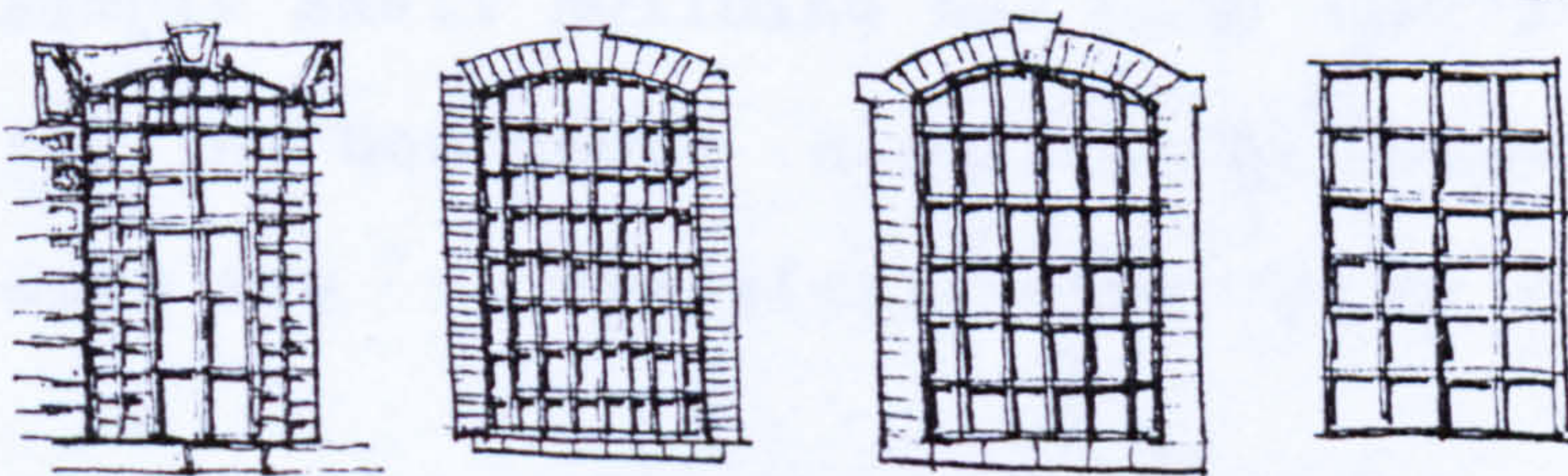


Fig.61. Patterns of windows

varies from mill to mill but in every case special care has been taken to emphasize its position in relation to the main production hall. In the IFEN mill the offices, which are attached to the shopfloor as a second storey, share common features with the typical facades of the houses of the area (fig. 62, 63, 64). A solid load bearing wall of the ground floor is combined with a light construction on the first floor with the vertically rectangular sashed windows. The corners of the building are dressed with wooden strips which outline the spatial volume and emphasize its boundary lines. A slightly projected hipped roof is covered with tiles.

A neoclassical treatment of the offices is the main feature of the other two examples (A.10 and A.14). The administration area of PELLA OLYMPOS (fig. 65) has common characteristics with the neoclassical houses of Naoussa (fig. 66) of the early 30's. The cubic volume surmounted with a hipped roof is covered with red roof tiles. The slightly projected eaves are emphasized by a decorative zone which runs along the upper part of the building. The corners are accentuated with quasi-corinthian pilasters which are treated architecturally but not structurally as corner columns. The windows are grouped vertically in pairs with a zone of different colour which runs down the facades. The result is that this simple small building has many similarities not only with the few bourgeois neoclassical houses of the town but also with the neoclassical buildings of Athens (fig. 67).

A classical pattern is used to emphasize the main entrance to the offices in NAOUSSA SPINNING MILLS (fig. 68, 69, A.9).



Fig.62.



Fig.64.



Fig.65.

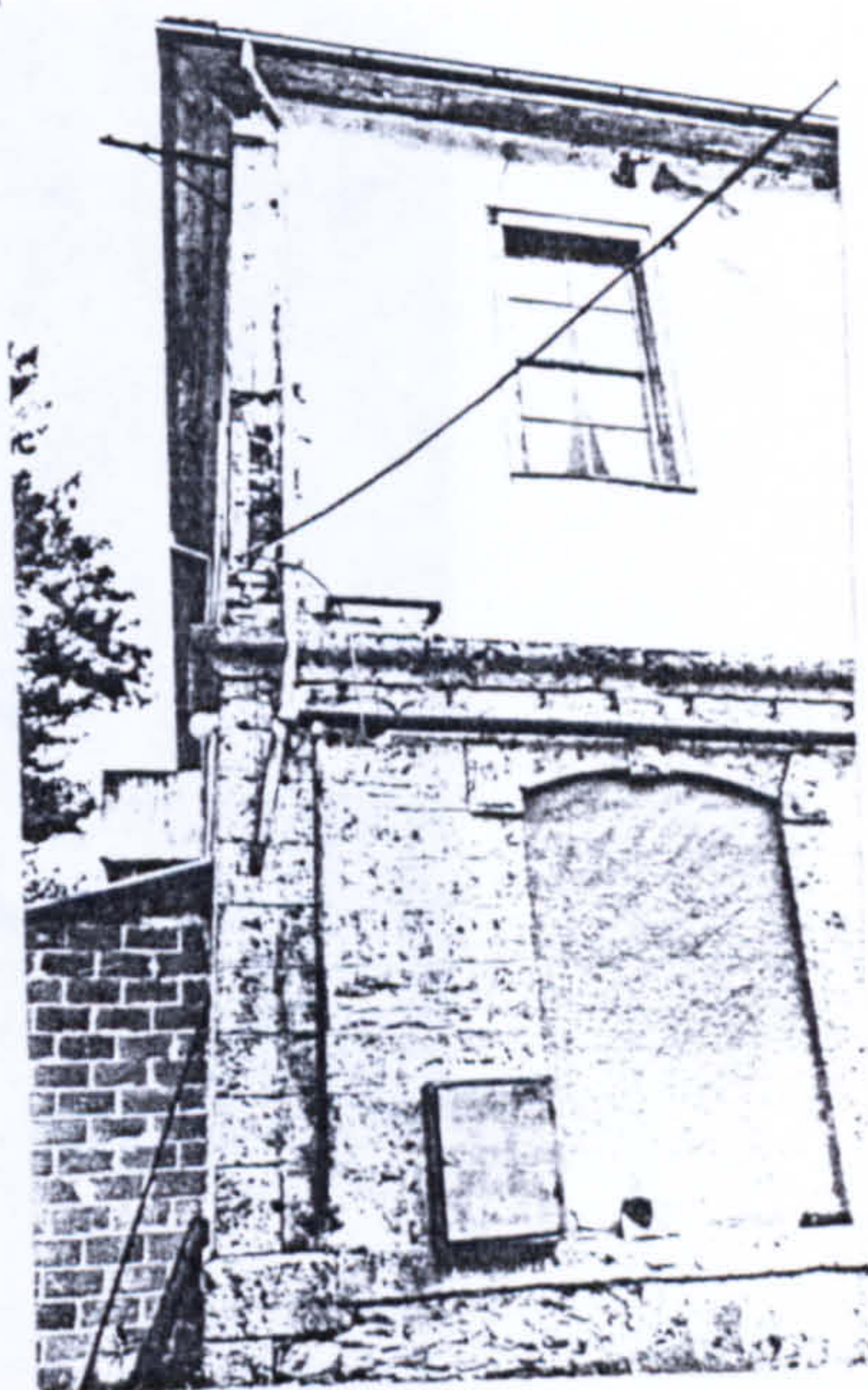


Fig.63

Fig.62. 'Ifen, A. Hadjiantoniou & Co' (A.6). View of the administration building, 1900's, (Naoussa)

Fig.63. 'Ifen, A. Hadjiantoniou & Co' (A.6). Detail of the corner of the factory and the offices. The windows of the ground floor have been blocked in, 1900's, (Naoussa)

Fig.64. Traditional house in the city of Naoussa

Fig.65. 'Pella-Olympos, Maced. Spinning & Weaving Mills' (A.10). View of the offices from the courtyard, before 1920, (Naoussa)

Fig.66. Bourgeois house of the 30's in Naoussa



Fig.66.



Fig.67. Neoclassical building in the centre of Athens (Vas. Sofias str.)



Fig.68. 'Naoussa Spinning Mills' (A.9). View from the main road, 1938, (Naoussa)



Fig.69. 'Naoussa Spinning Mills' (A.9), 1928, (Naoussa)

The unpedimented Tuscan portico is superimposed on the main facade. This simplified portico with the architrave reduced to the minimum and its delicate balusters tries to comply with the industrial character of the building which is a long, high and unadorned block. The external columns project slightly and like the architraves of the windows relieve the otherwise plain facade. Stylistic gestures are avoided for the whole building. It may be argued that the portico-the only decorative element-affirms the intention to combine classical Greek precedent with European modern. This way of emphasizing the entrance has been favoured also in the design of schools of the town (fig. 70, 71) in the 30's and even later in the 50's.

The delicate building used by the administration of the firm SEFECO (fig. 72, A. 11) was originally a hospital constructed in 1918 by the French. Despite the similarities with the local traditional architecture, it has several characteristics which are not local. For instance, the shape of building volume - especially the relationship between the attic and the ground floor (broader base than first floor) - the form and ratios of the portico and the form of the windows are not features of the traditional buildings of the area. The plans were imported from France. Since it was built the building has been changed. The attic originally had a hipped roof, the main window above the portico was round, and the windows were rectangular with arches. Most of these features are preserved nearly unchanged in another hospital (fig. 73) of the same period constructed

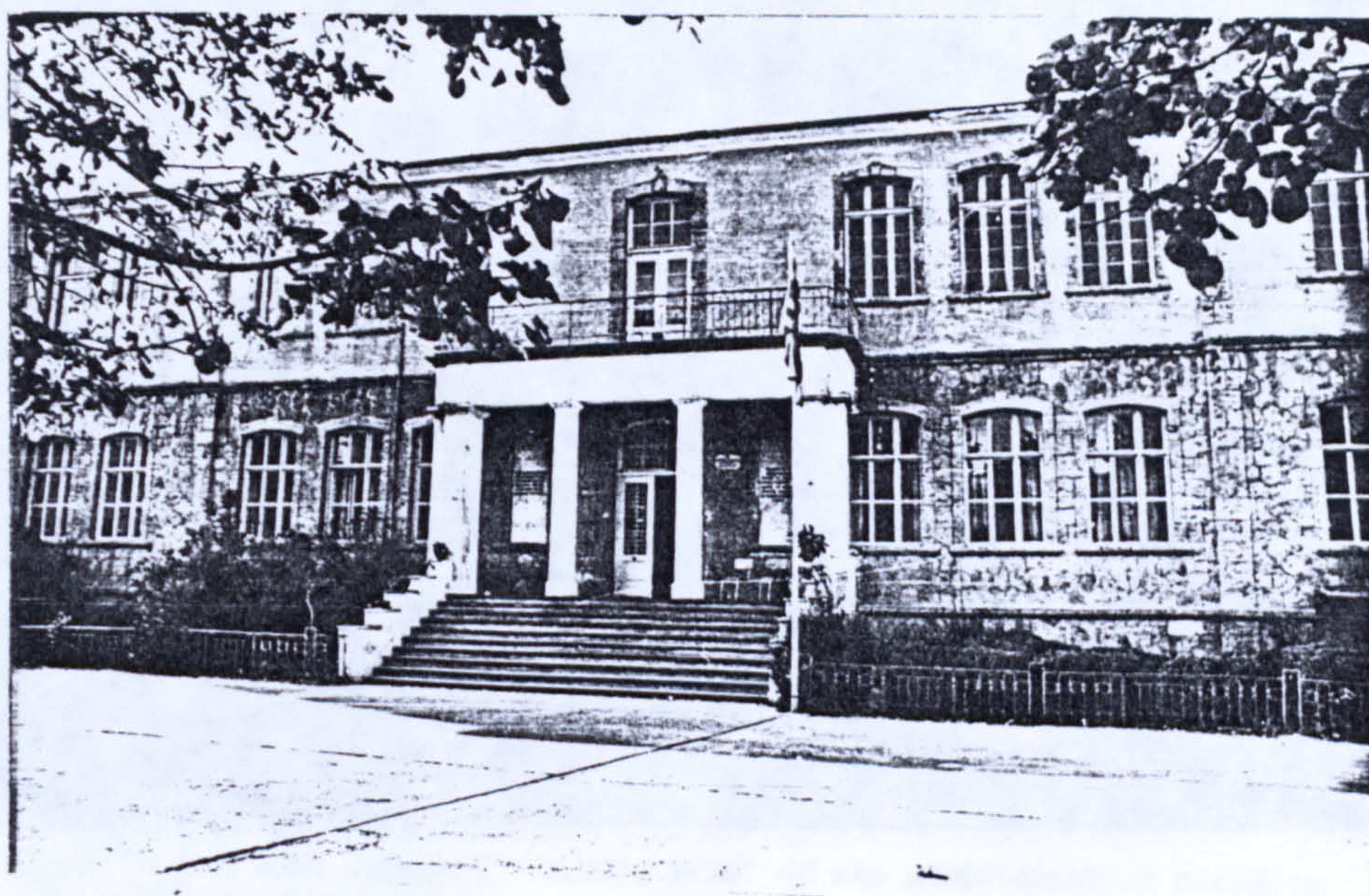


Fig.70.School in Naoussa of the early 50's



Fig.71.School in Naoussa of the early 30's



Fig.72. 'Sefeco Wool Industry' (A.11): View of the administration building, 1930's, (Edessa)



Fig.73. This hospital is larger than Sefeco's administration building. The lower part is a recent addition. The building is now used by the church.

in the town of Githio, in southern Greece.

The formal language used in the mills of Athens, Thessaloniki, Patra and Lavrio during the inter-War period has great variety. The majority of buildings display influences from the Modern movement which was popular then in Greek architectural circles. Three buildings of the sample out of eleven, (fig. 76,77,78) constructed during this period, have similarities with the buildings of Edessa and Naoussa and especially with those of the firm SEFECO (fig. 74, 75). The complex of TSITSIS AND SONS MILLS (fig. 79) constructed in Thessaloniki in 1921 reminds one a lot of PELLA OLYMPOS mills (A.10) in Naoussa from where the owners came.

Two other cases (A.17, A.20) do not exhibit any particular architectural character at all. Their structural cell fulfills only functional requirements. Stylistic gestures have been avoided. Their overall volumes, interrupted by patches of linear windows, give the impression of an accidental accumulation of spaces (fig. 80, 81, 82, 83). In contrast to the production buildings stands the small and simple office building of LAVRION SPINNING MILLS (fig. 84) at the corner of the site. This building like the office building of RETSINA (fig. 85) is like the typical popular house of the beginning of the century of Lavrio and Piraeus.

The rest of the mills in Athens and Thessaloniki apparently show clear influences of the Greek Modern Architecture¹⁵ developed in the period between the Wars along with the European Modern movement. The most important collective expression of the Greek Modern movement in architecture

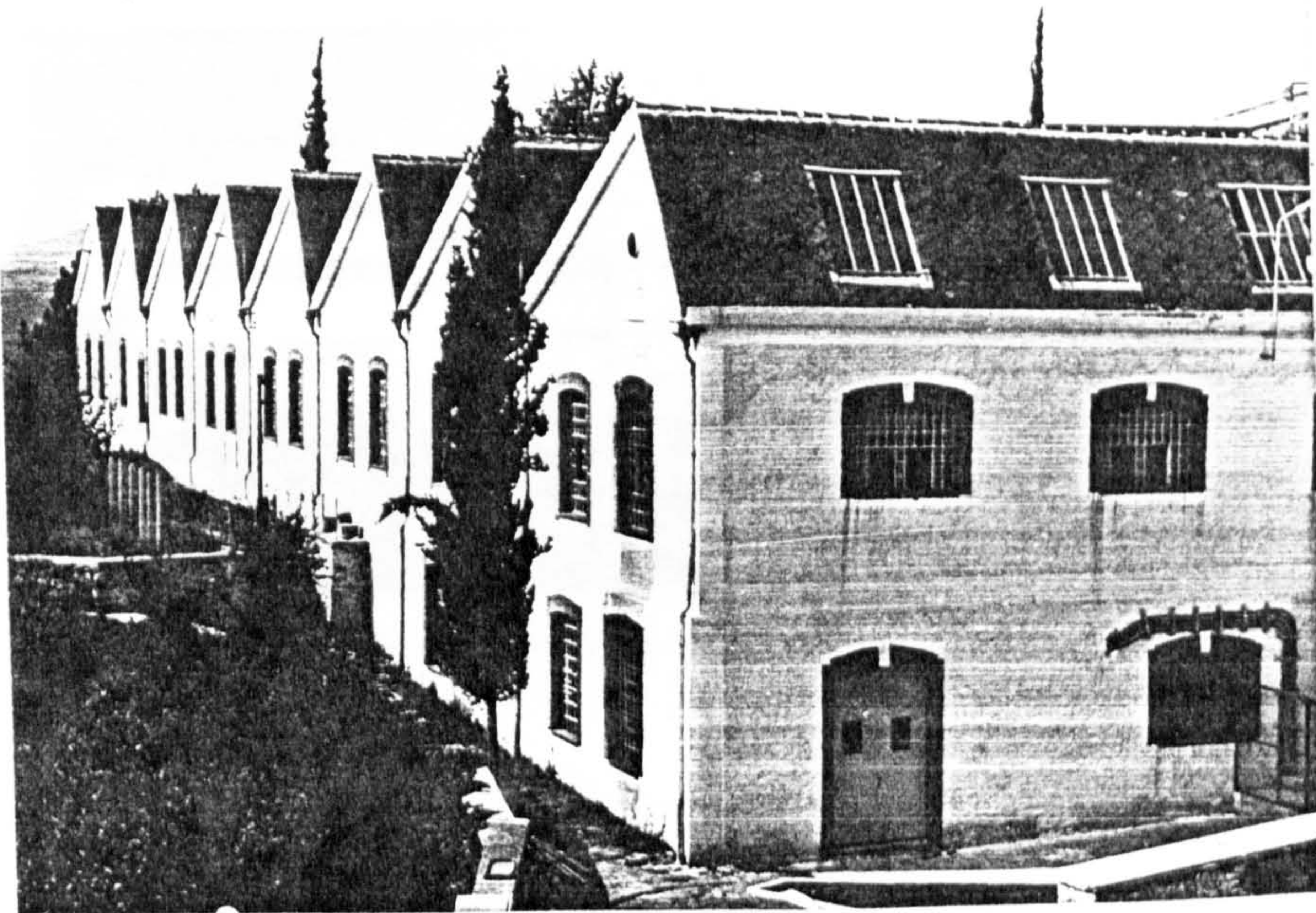


Fig.74. 'Sefeco Wool Industry' (A.11), 1930's, (Edessa)



Fig.75. 'Sefeco Wool Industry' (A.11), 1930's, (Edessa)

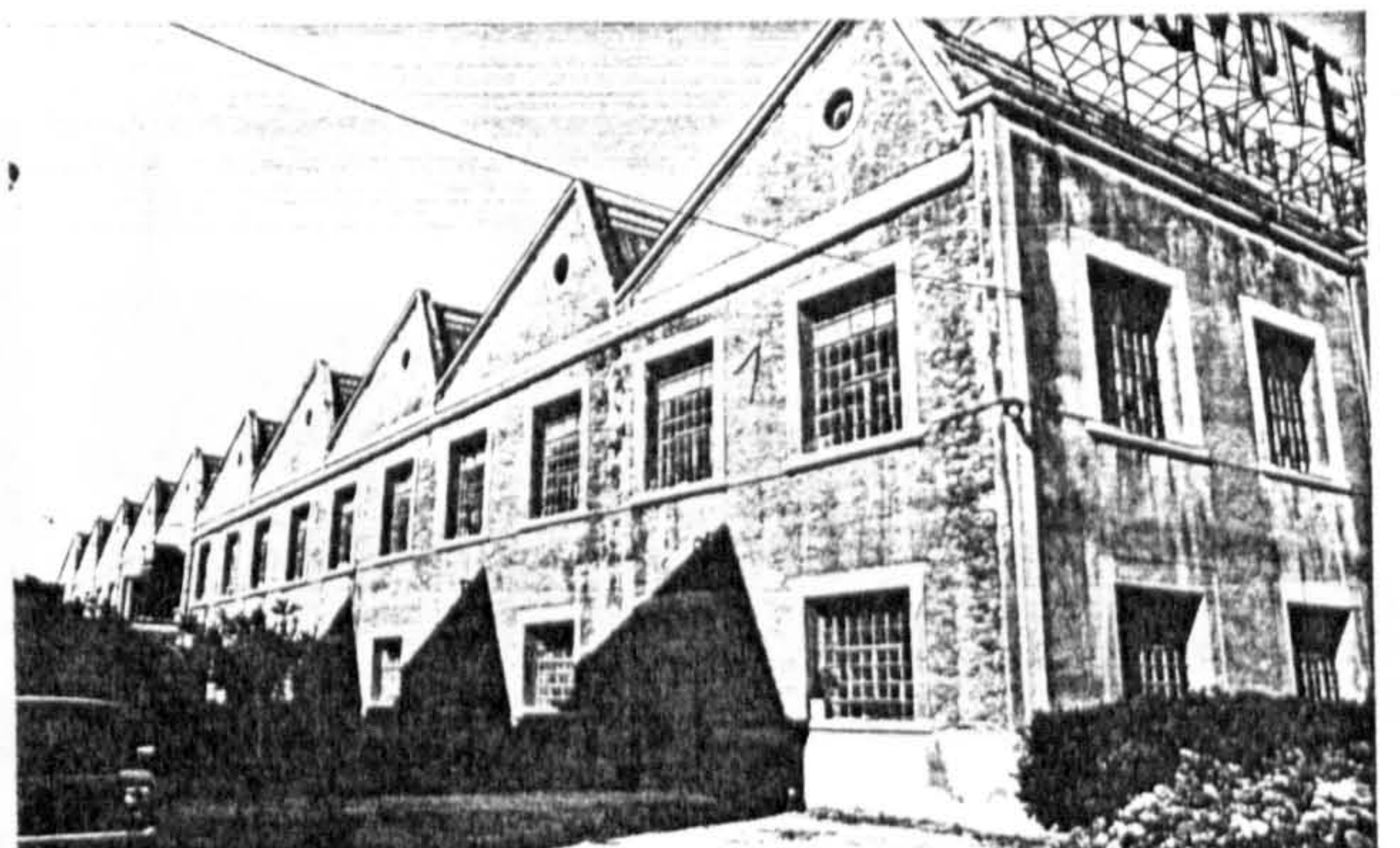


Fig.76. 'Sigaras, C. Wool Industries' (A.12). View of the building used for spinning, 1925, (Athens).

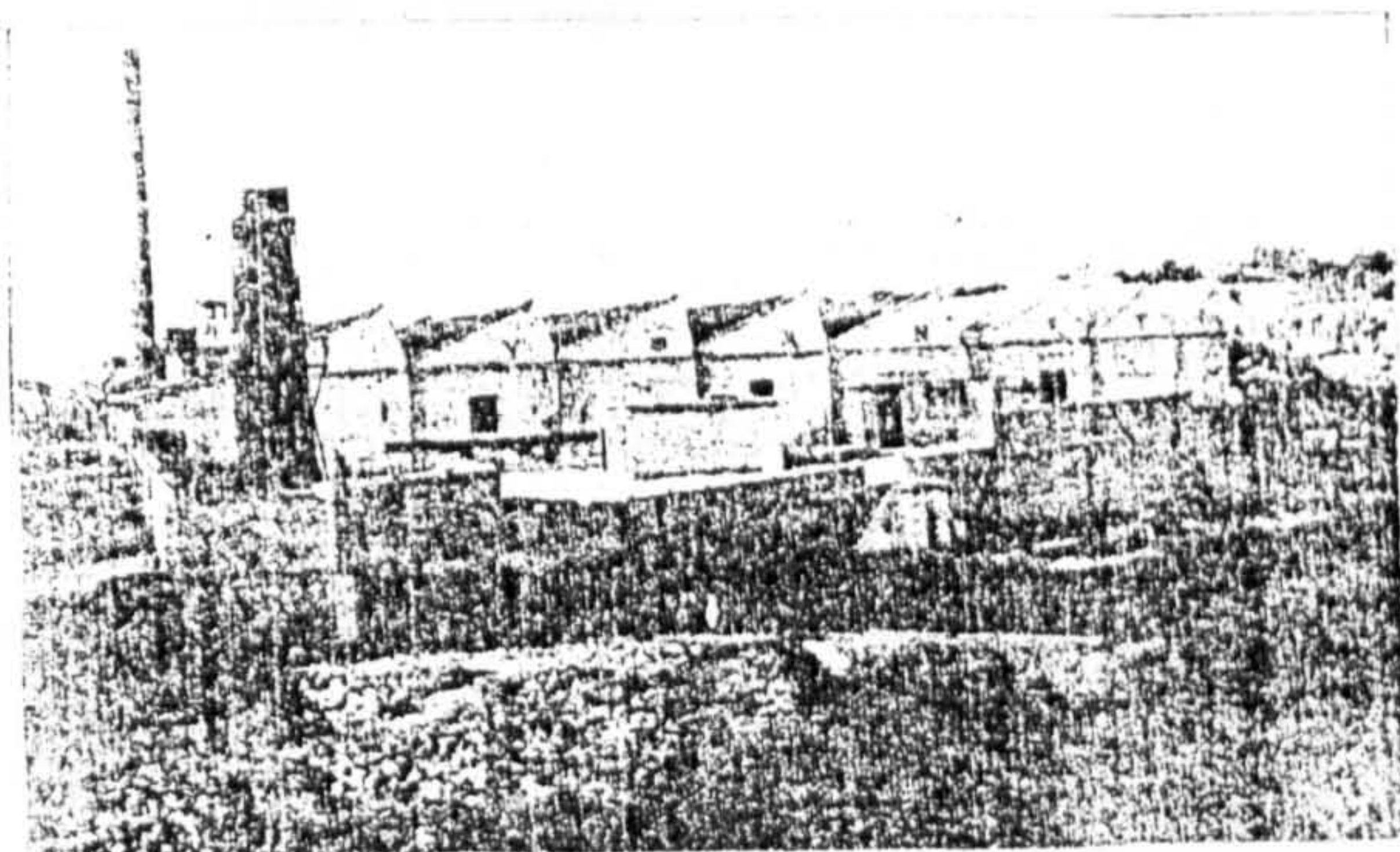
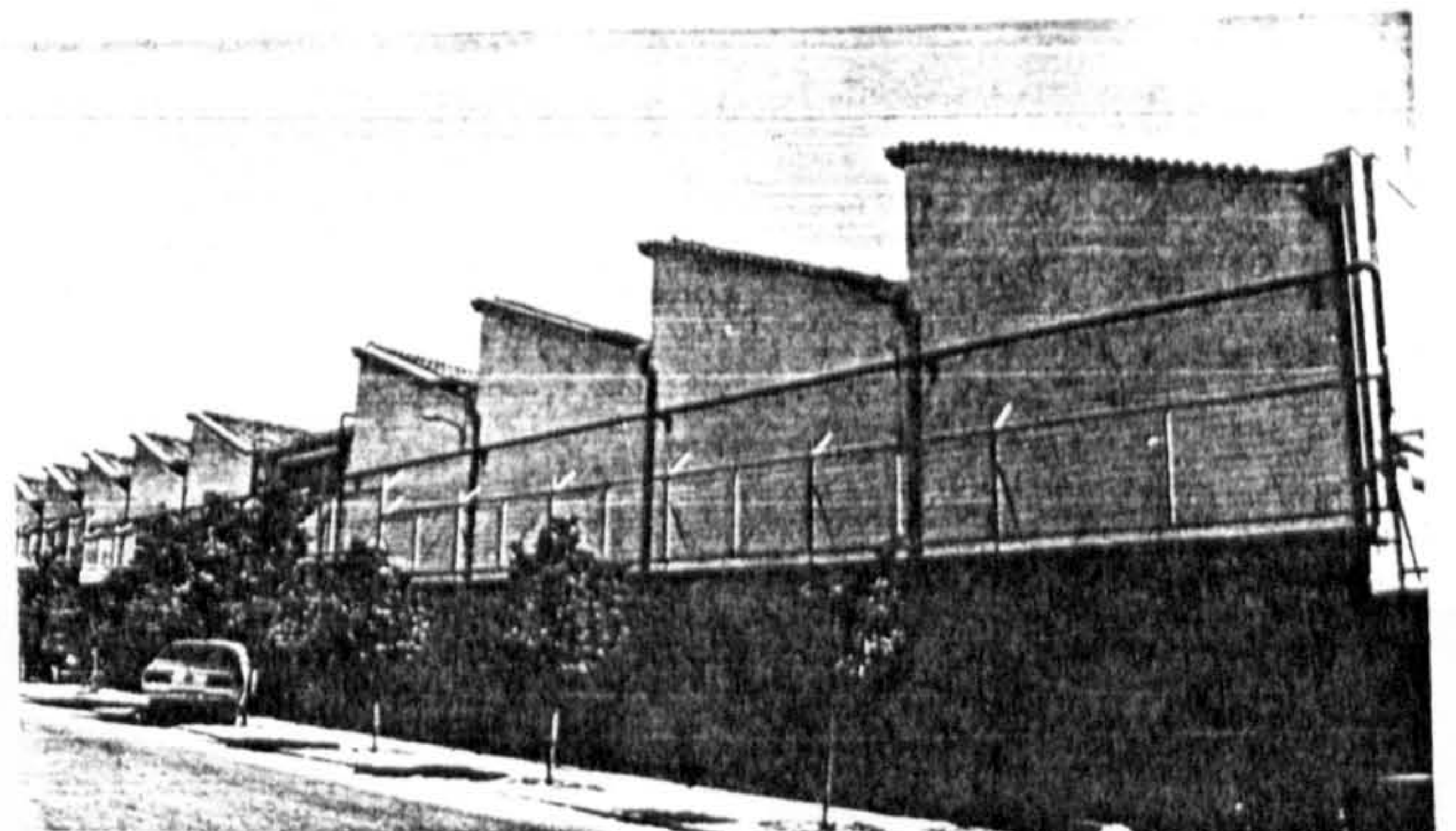


Fig.77. 'Ifanet' (A.7). The first premises of the Fig.78. 'Piraiiki Patraiki Cotton Manufacturing Co' firm, 1911, (Thessaloniki) ¹³



(A.13). The similarities with the other buildings are not apparent due to the blocking of the windows, 1930's, (Athens)

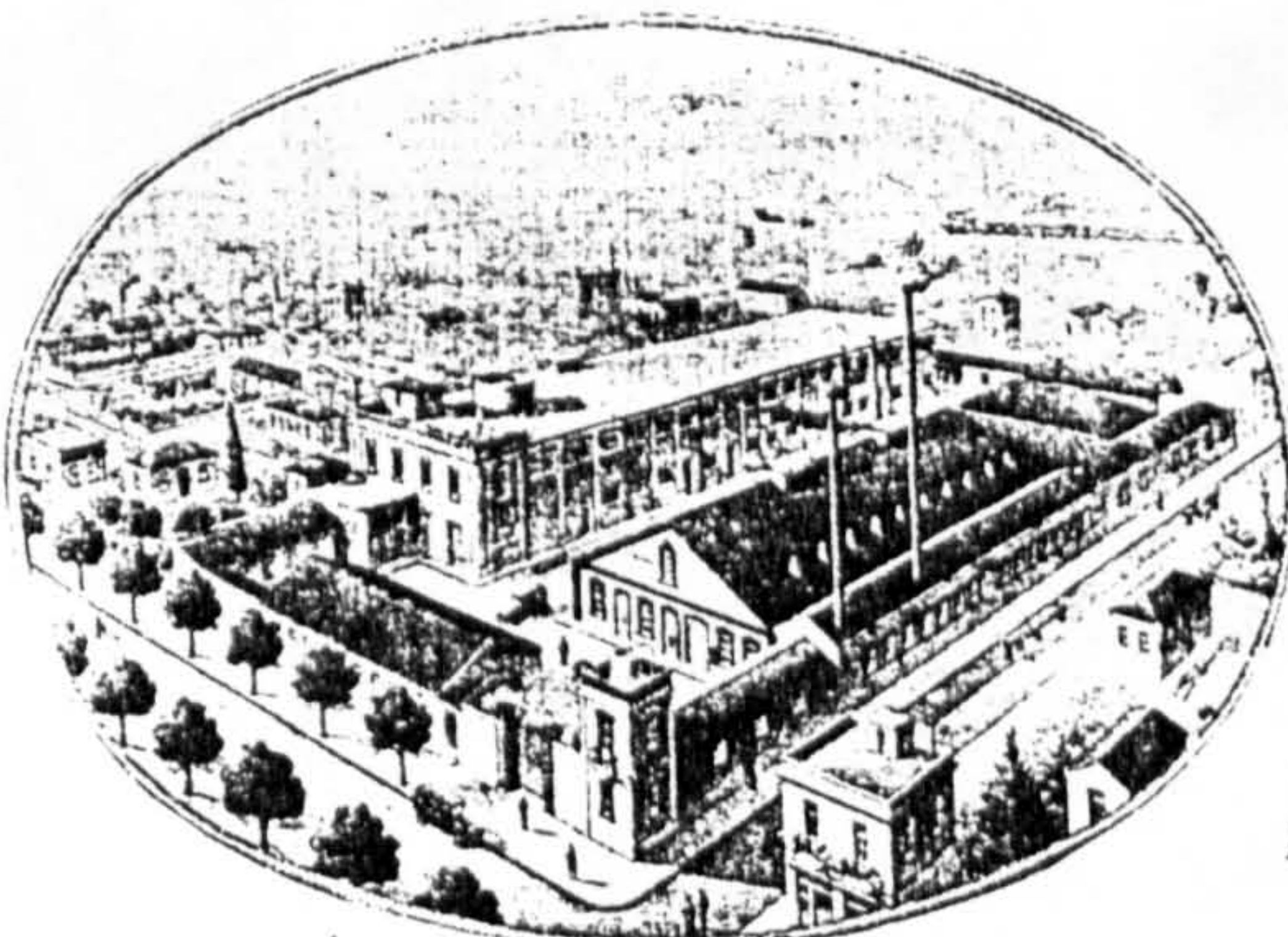


Fig.79. 'Teitsis & Sons Mills'. It has been demolished, 1921, (Thessaloniki) ¹⁴

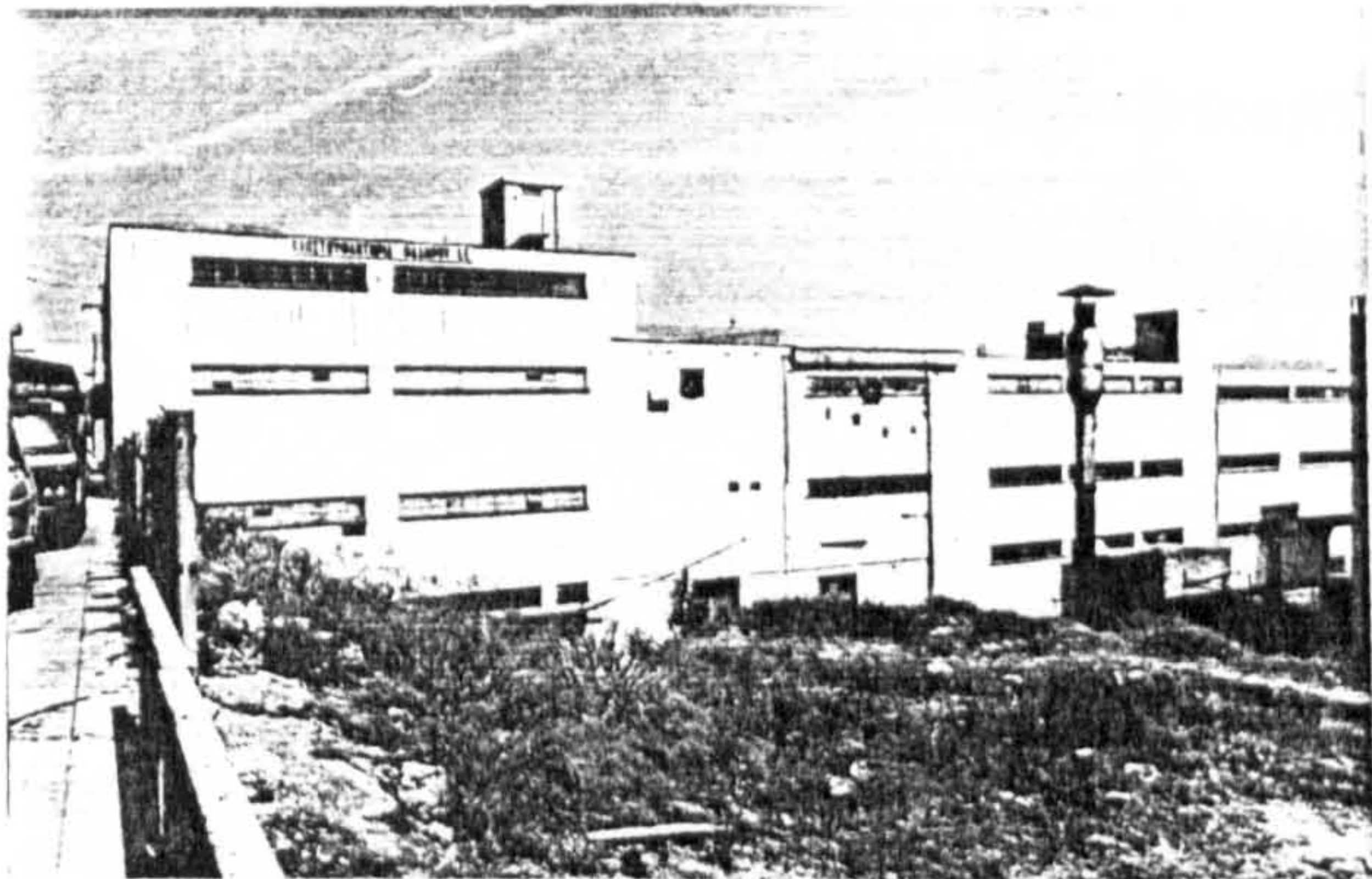


Fig.80. 'Phaleron Spinning & Weaving Mills' (A.18), 1931, (Athens)



Fig.81. 'Phaleron Spinning & Weaving Mills' (A.18), 1931, (Athens)



Fig.82. 'Lavrion Spinning Mills' (A.20). View of the back part of the production hall, 1938, (Lavrion)

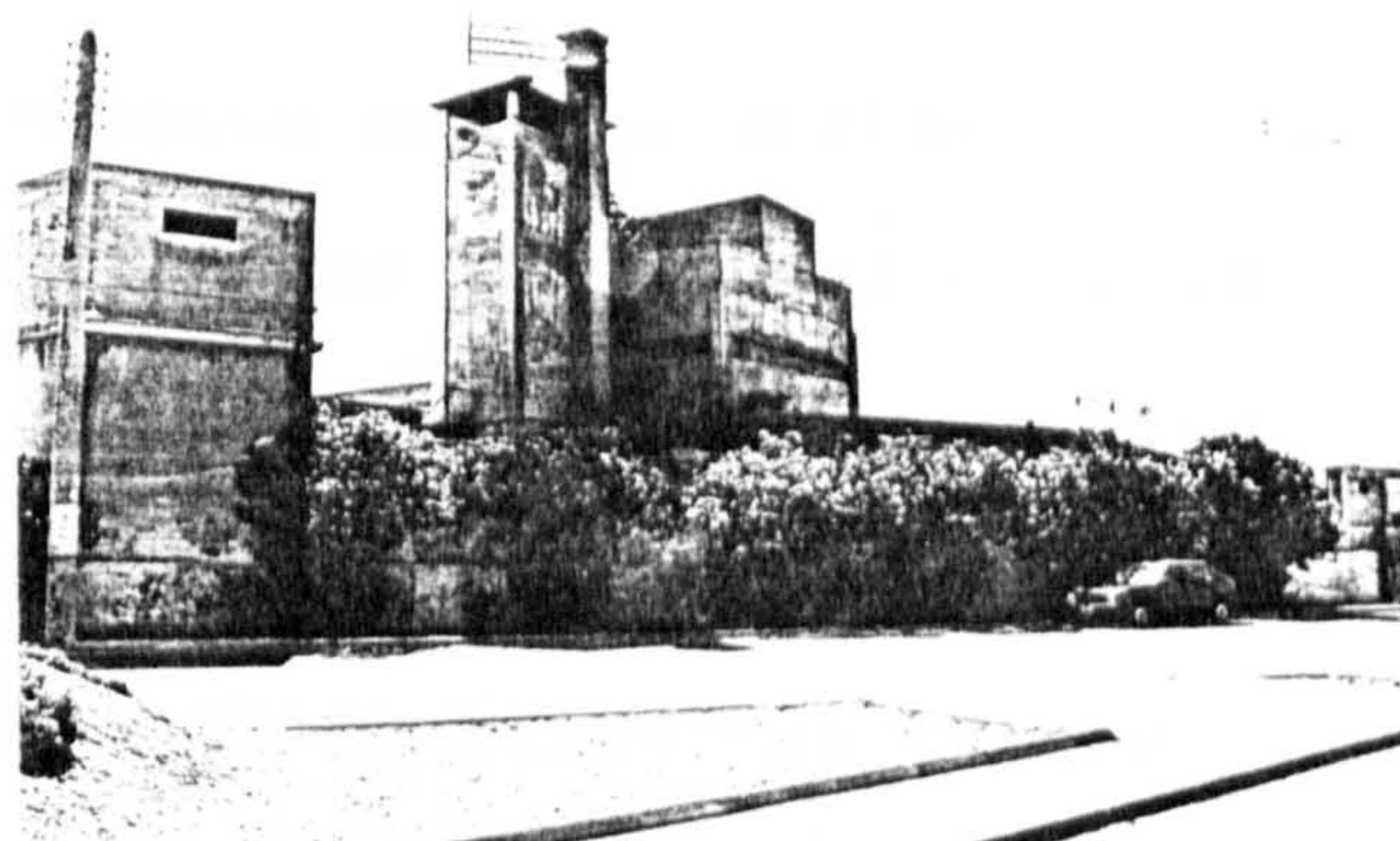


Fig.83. 'Lavrion Spinning Mills' (A.20), 1938, (Lavrion)



Fig.84. 'Lavrion Spinning Mills' (A.20). View of the administration building, 1938, (Lavrion)



Fig.85. 'Retsina Bros, Spinning & Weaving Co' (A.1). View of the offices' building from the road, 1872, (Piraeus)

is the programme of the construction of school buildings in the '30's all over the country (fig. 86). The same principles seem to have underlain the design of both mills and schools using a similar architectural language. The need for economic, easy and rapid construction in both cases is expressed and fulfilled with the design of simple rectangular volumes traversed only by almost continuous windows. Even in cases where the mill is a complex of single storey roof lighted buildings and flat roofed multi-storey buildings, the modern treatment is apparent (fig. 87-95). A typical characteristic of all these examples is that the administration area, the warehouse and the worker spaces can hardly be distinguished since the formal cell is like a neutral cover for every function, sometimes complex and unarticulated. This fact differentiates the architecture of mills from the architecture of school buildings of the same period despite their superficial formal similarities.

The echo of the Renaissance in Greek architecture of the early years of the century finds expression in one unique building; the ATTICA SPINNING MILLS (A.14 and fig. 96). The symmetrical articulation of the volume, the tripartite articulation of the facades, the corner towers terminating the long facade surmounted by curved hip-roofs, and the central impressive projection of the volume covered with a domed roof are an ambitious adaptation of Renaissance principles to an industrial building. It is very likely that the designer is influenced by Ernest Tsieler, a German architect, who lived and worked in Athens for many years at the end of the nineteenth century and designed

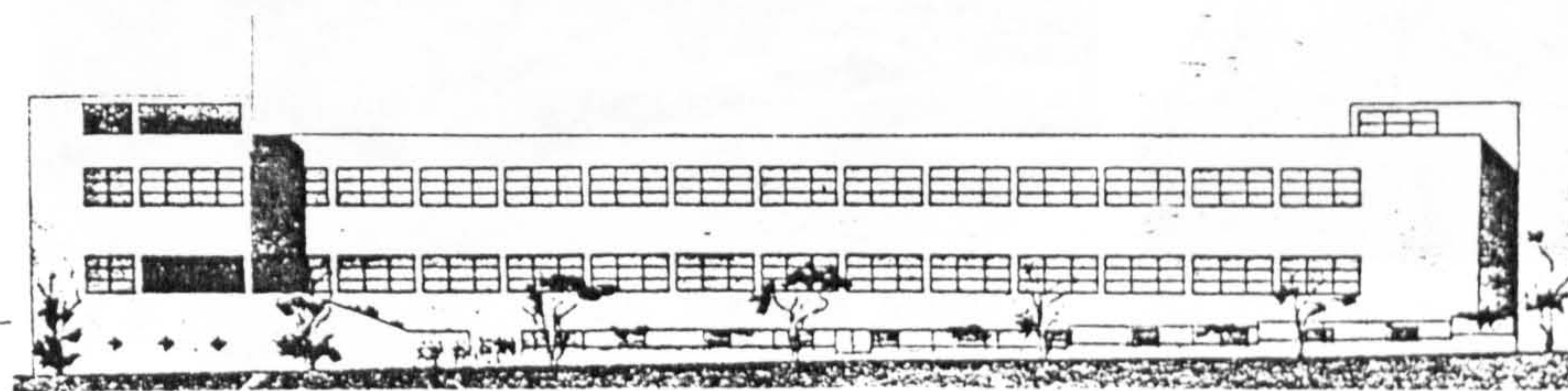
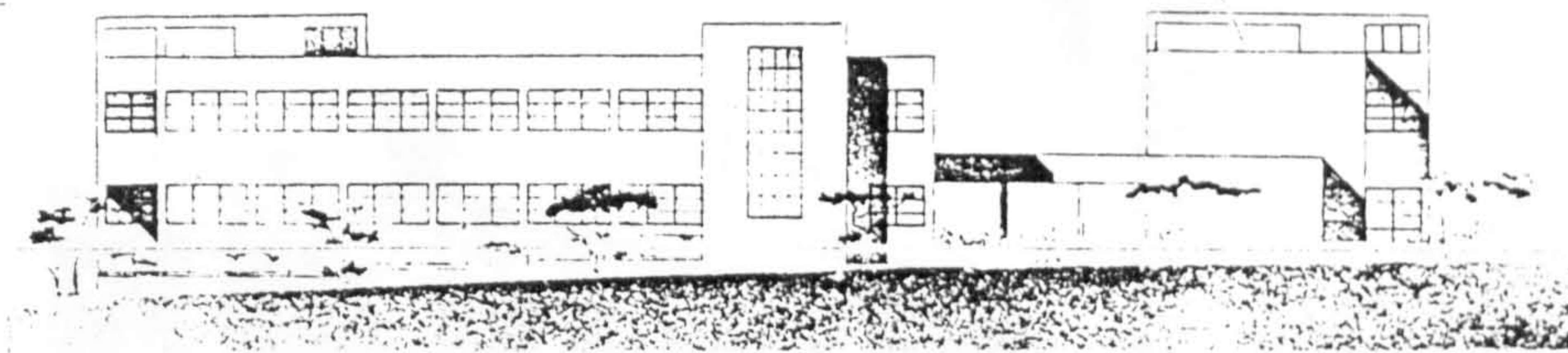


Fig.86. School in Thessaloniki, 1935-36, Arch. T. Valentis 16



Fig.87. 'Minaidis-Fotiadis Wool Industry' (A.15), 1930's, (Athens)

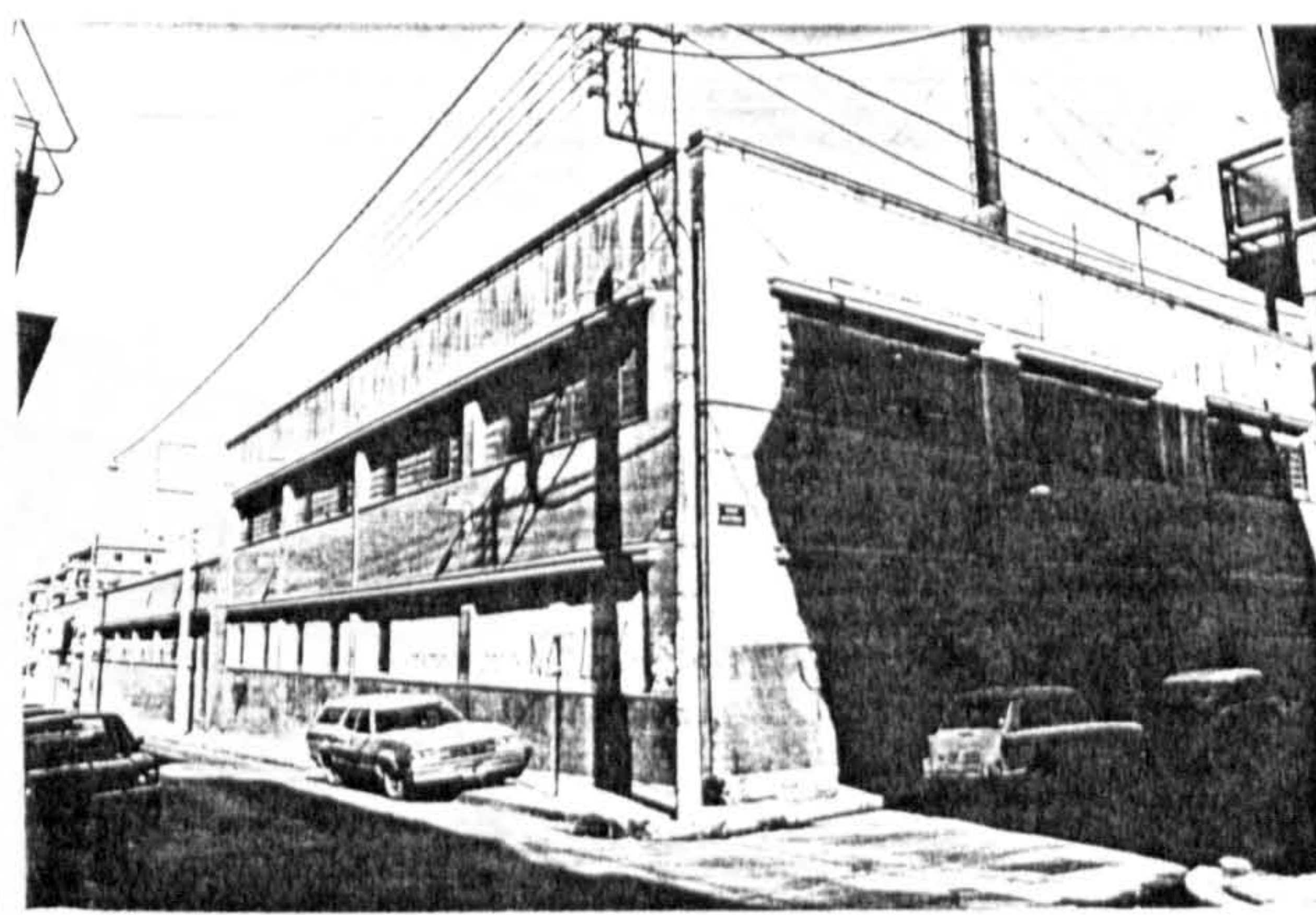


Fig.88. 'Minaidis-Fotiadis Wool Industry' (A.15), 1930's, (Athens)

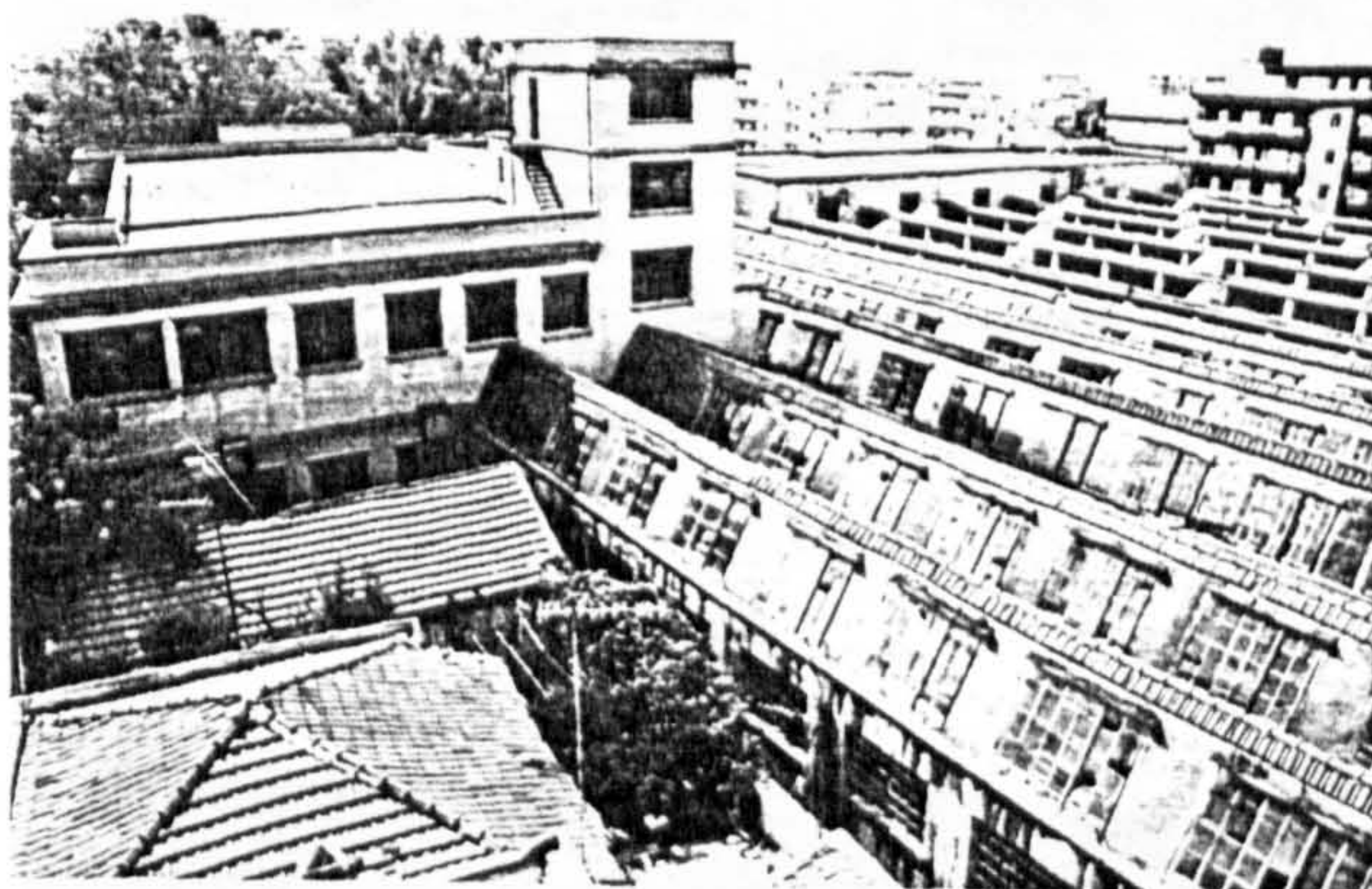


Fig.89. 'Ifanet' (A.7). View of a part of the complex from the air, 1911, (Thessaloniki)

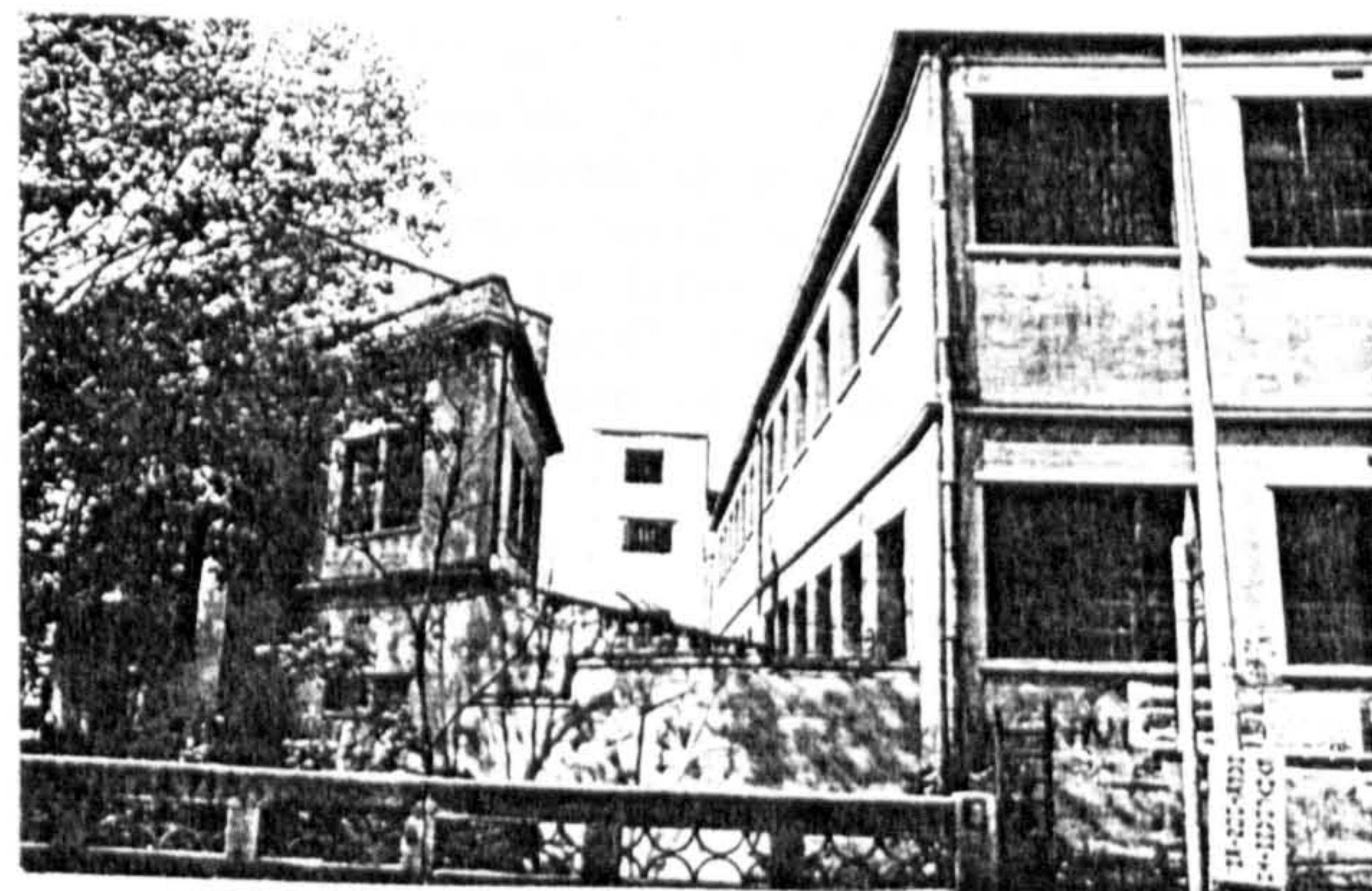


Fig.90. 'Ifanet' (A.7), 1911, (Thessaloniki)



Fig.91. 'Kriticos, H.' (A.19). The main facade, 1930's, (Patra)

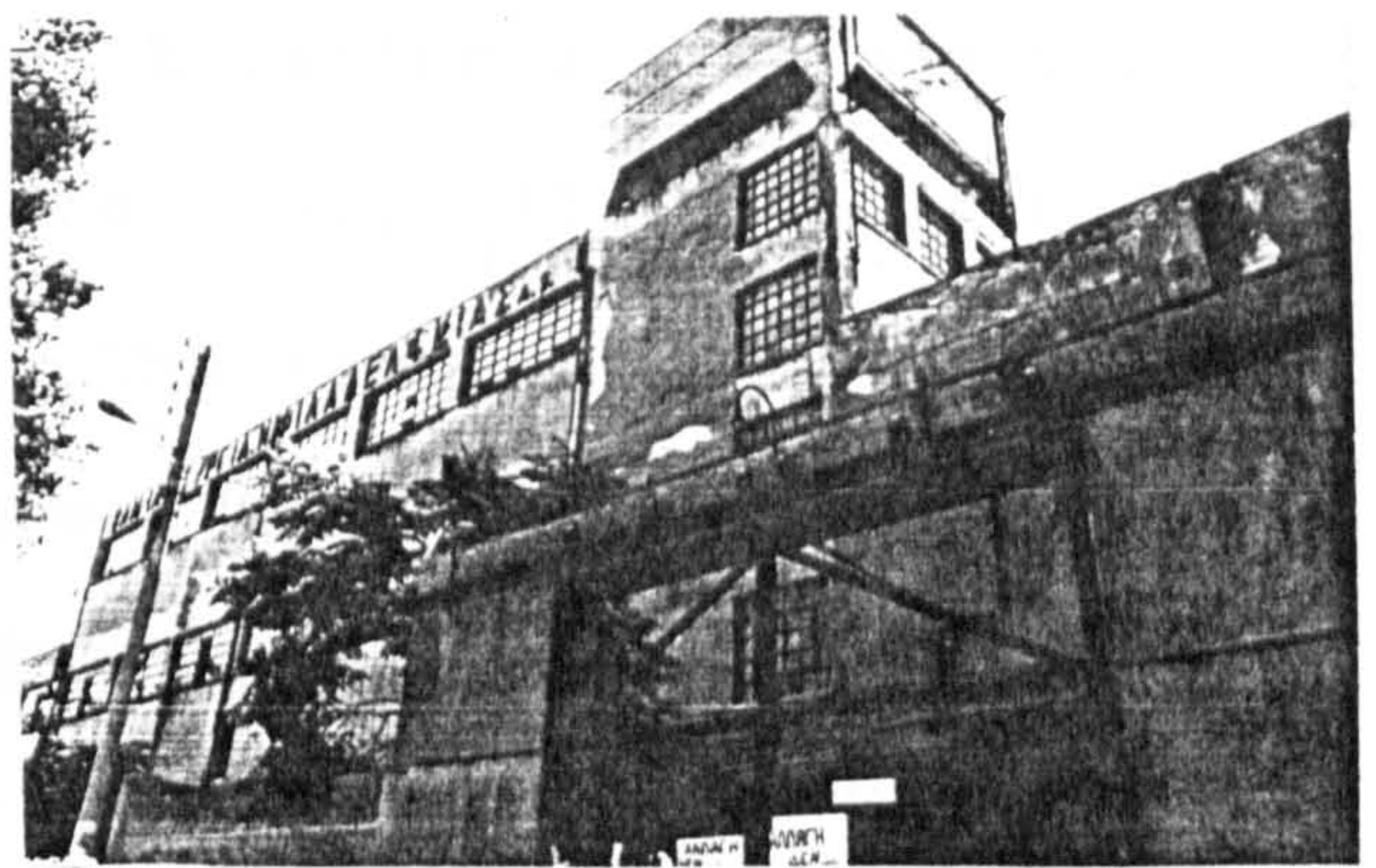


Fig.92. 'New Philadelphia Cotton Mills'. It is now used by a few small manufacturing firms, 1930's, (Athens)



Fig:93-94-95. 'Ilios' (A.16). Views of the complex from the surrounding roads. The crowstep gable roof of the corner building is not commonly used in Greek architecture. This 'borrowed' element appears just this once in mills, 1936, (Thessaloniki)



Fig.96. 'Attica Spinning Mills' (A.14). Main facade of the old mill, 1930's, (Athens)

many public and private buildings. E.Tsiler's drawings for the Hall of Justice of Athens (fig. 97, 98) have formal elements in common with the mill. The Renaissance architectural principles are interwoven with modern ideas about industrial building design (fig.99,100), to produce a building renaissance in overall character but industrial in detail. The present owners of the firm preserved the old building and expanded their activities to a modern addition (fig.101-103). They seem to be interested in the symbolic connotation of the old building since they believe that the close interplay of the modern addition with the impressive older building expresses better than anything else the continuous prosperity of the company covering a life of sixty years.¹⁹

Another impressive building is the early mill of FOUSTANOS (fig. 104, 105) in Piraeus constructed after the turn of the century. Another notable building of the same period is that of CARELLAS MILLS (fig. 106), which is somewhat similar to P.Behrens' early constructions (fig. 107).

After World War Two, variety and regional characteristics are replaced by uniformity, order and clarity. The formal vocabulary during the 40's and 50's is mainly based on the modern repertoire enriched in some cases by classical elements which are usually superimposed on the facades to mark the main entrance of the building.

When modern ideas are the only generative forces in the design, the buildings are simple, rectangular and with sharp outlines. Their external surfaces are smooth without

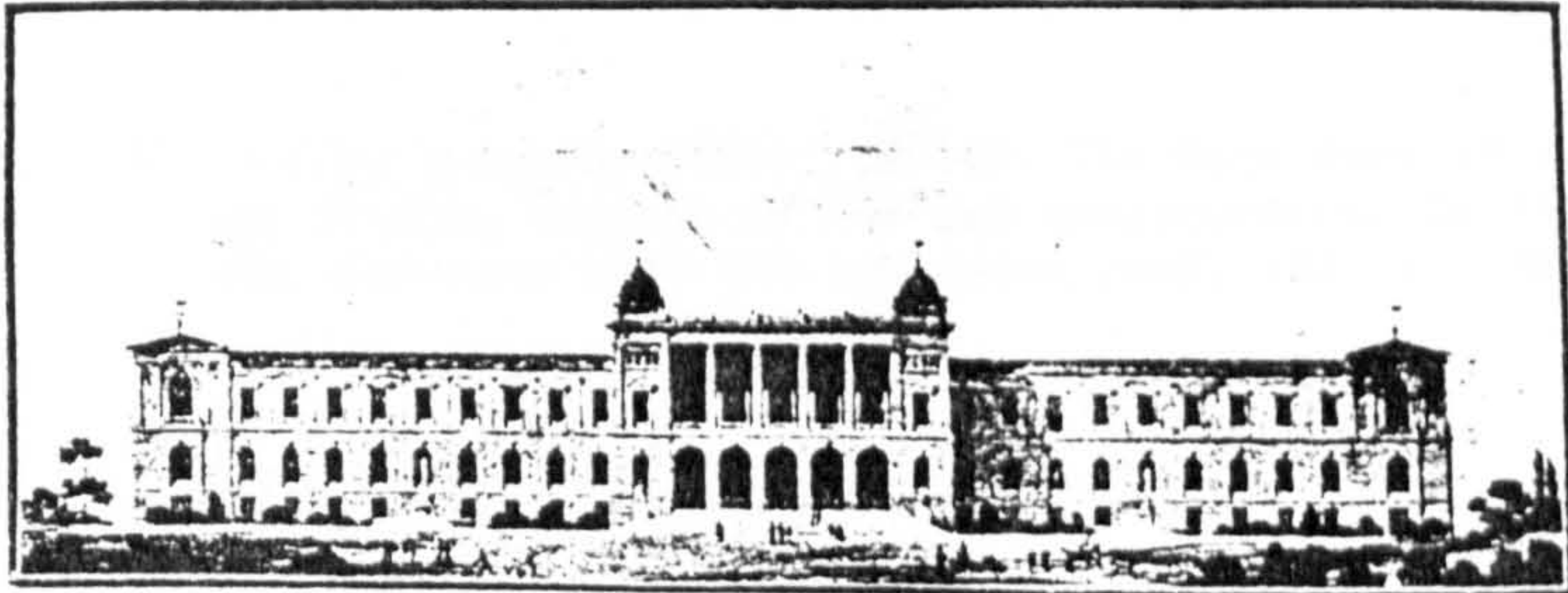


Fig.97-98. Two drawings for the Court of Justice of Athens by E.Tsiler¹⁷

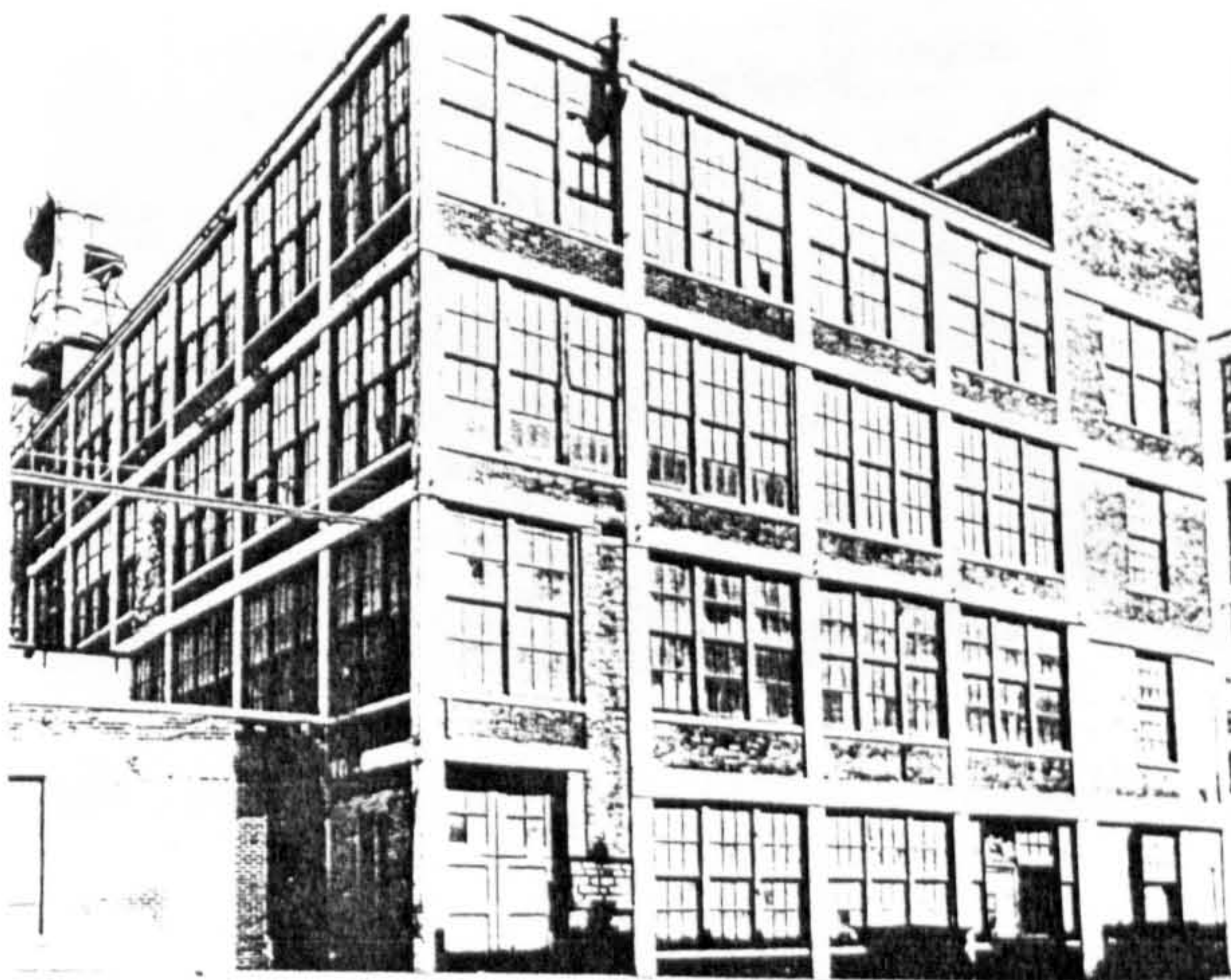


Fig.99. Packard's number ten plant designed by A. Kahn. One can observe the details in common with the Attica Spinning Mills, 1905¹⁸



Fig.100. 'Attica Spinning Mills' (A.14). View from the corner, 1930's, (Athens)



Fig.101. 'Attica Spinning Mills' (A.14). General View of the old and the new building. Their architecture expresses an intentional contradiction, 1930's, 1970's, (Athens)

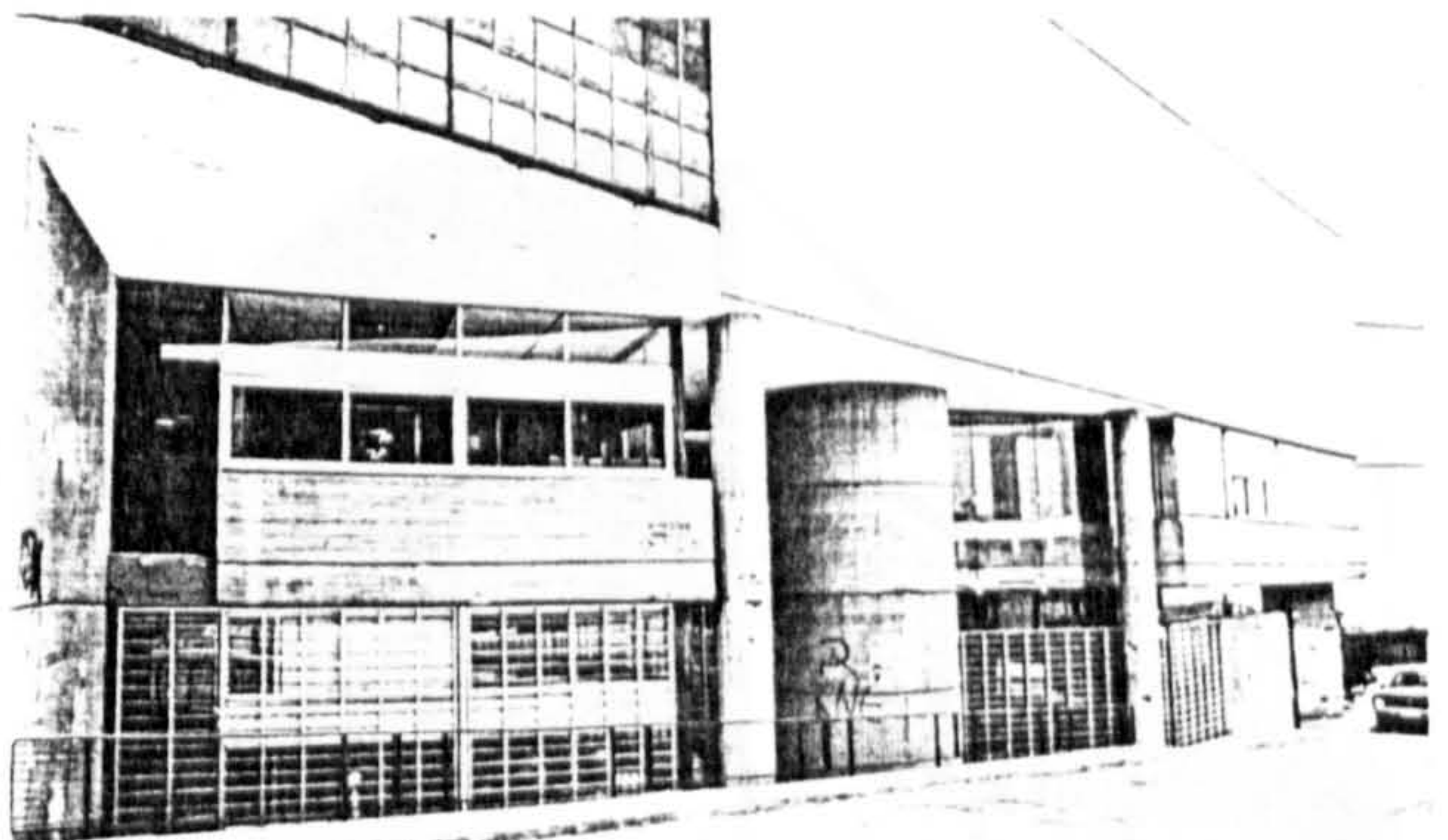


Fig.102. 'Attica Spinning Mills' (A.14). View of the entrance to the offices which are part of the recent addition, 1970's, (Athens)



Fig.103. 'Attica Spinning Mills' (A.14). The back part of the old mill is not visible because of the new construction. On the left is the old warehouse with the saw tooth roof, 1930's, (Athens)

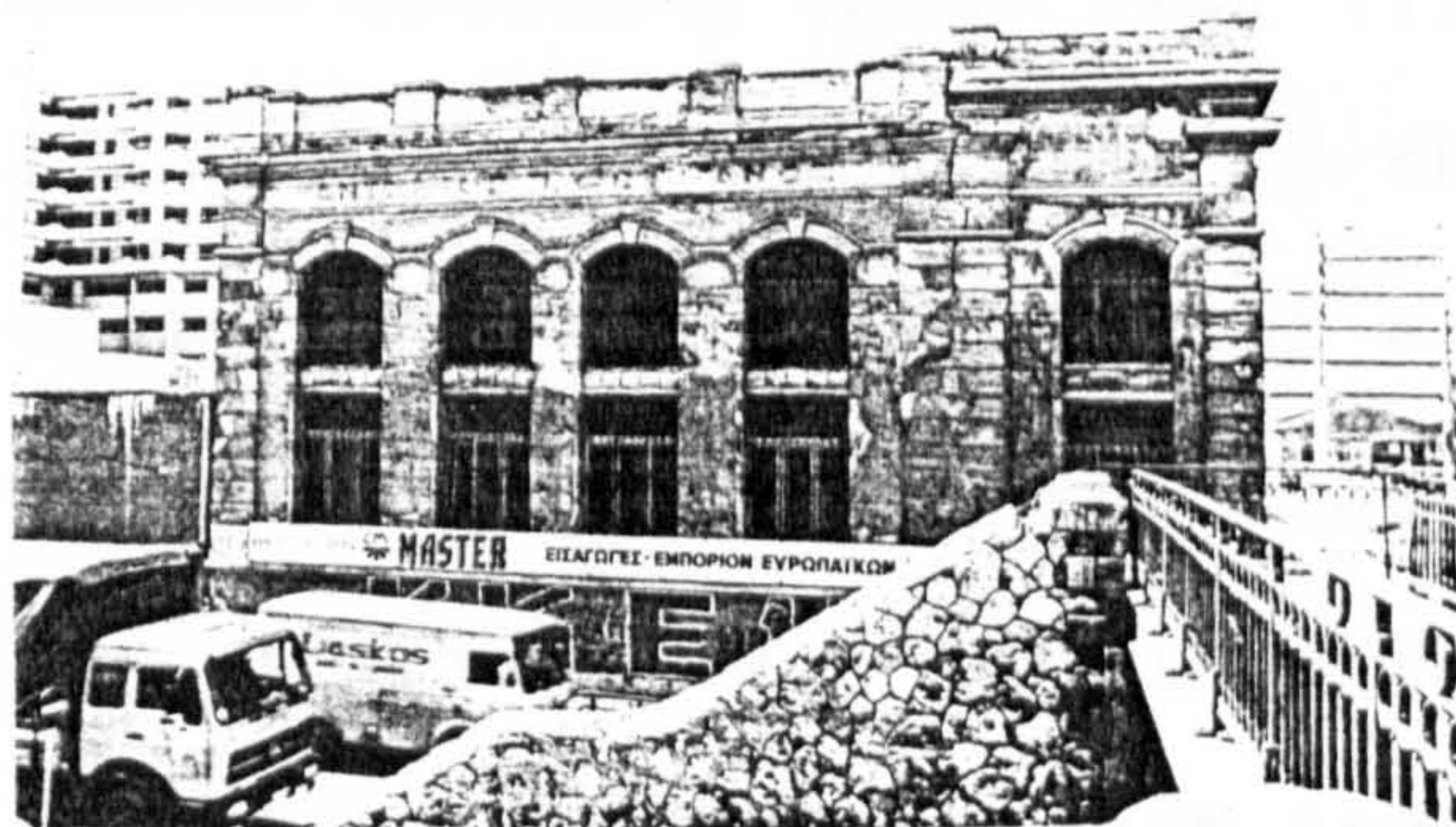


Fig.104. 'Foustanos, A.', 1900's, (Piraeus)

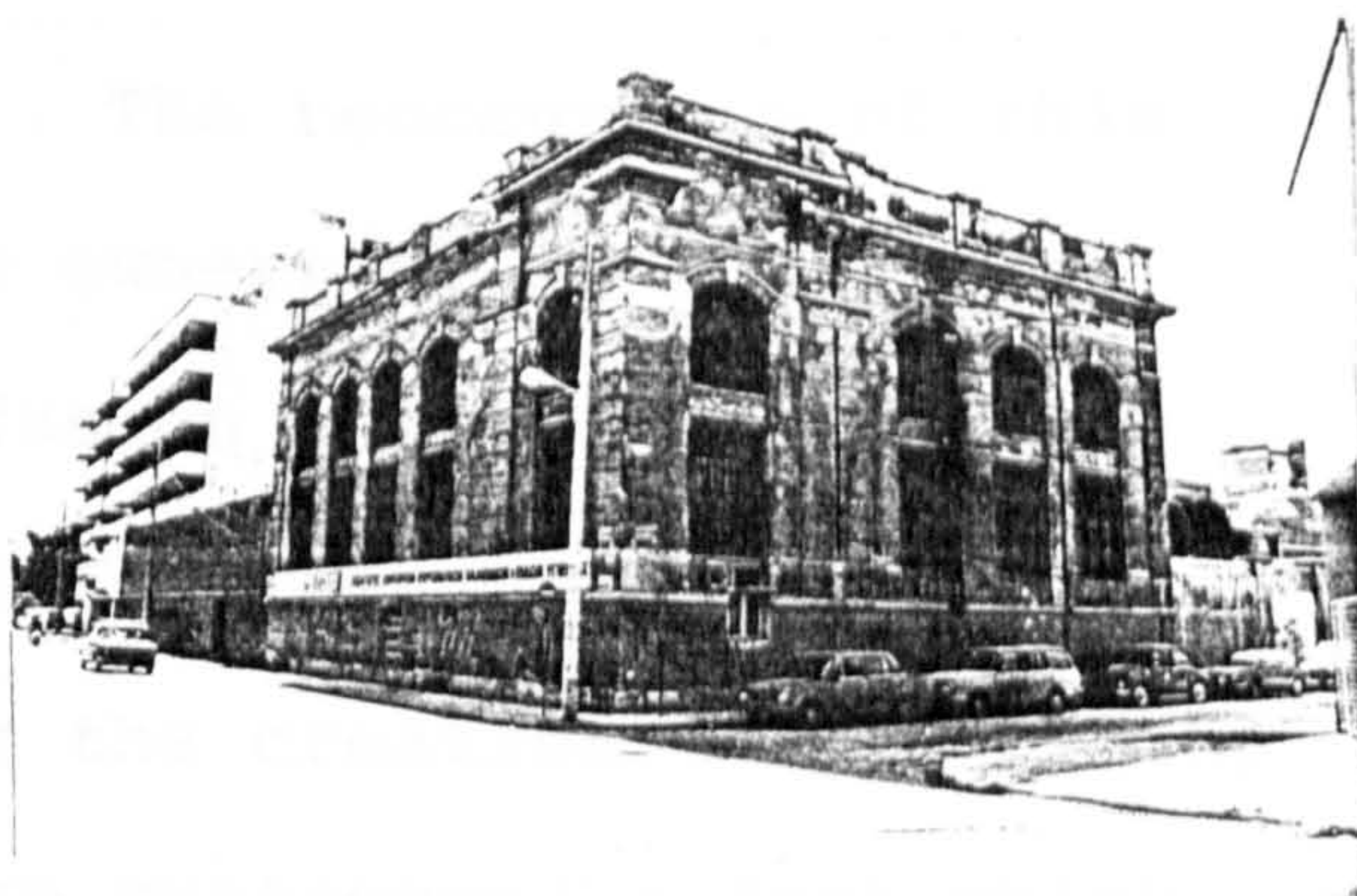


Fig.105. 'Foustanos, A.', 1900's, (Piraeus)



Fig.106. 'Karellas Mills', 1922, (Athens)²⁰

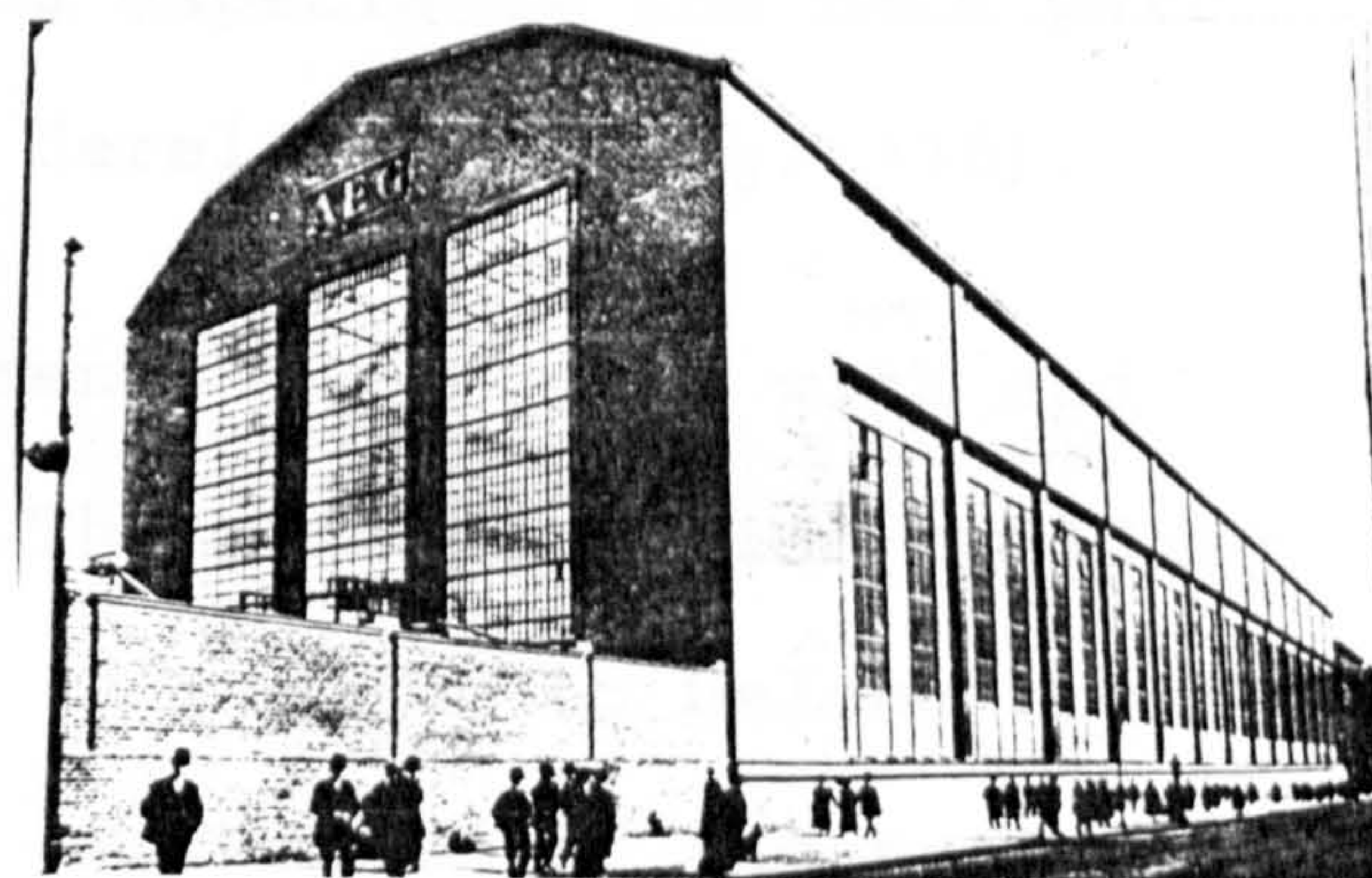


Fig.107. AEG factory. View from Hussitenstrasse, Arch. P.Berens, 1913, Berlin²¹

projections or differentiation of materials, interrupted only by the long linear windows (fig. 108-111). The voluminous impression of these buildings is avoided in case of SACALIDES (fig. 110, 111) since the vertical projection of the columns of the facades and the network treatment of the main facade of the spinning shopfloor creates an interesting variety of forms which do not betray the actual size of the building.

A feature that seems to appear again in this period is the unpedimented portico, either ionic or quasi-Tuscan which was employed to emphasize the entrance of an undoubtedly modern building (fig. 112, 113). The reoccurrence of this feature shows the desire of the owners of the firm to accentuate the existence of a fusion between the modern-European thought and the classical Greek principles. These are the necessary premises for the creation of a building impressive both to workers and to customers; a fact which is expected to have consequent effects on the quality of the product, the reputation of the firm and the sales turnover. In some cases this aim is limited only to the creation of a barely acceptable facade with a well-designed entrance (fig. 114), whereas the rest and especially the back part of the building shows signs of dereliction (fig. 116).

In certain cases classical elements are fused with and governed by modern principles. The administration building of LANARAS-KIRTSIS MILLS (fig. 117) seems to belong to this category. The heavy and stable impression of the building discloses an image of immobilized movement. It has a plastic rectangular L-shaped volume which has attained its

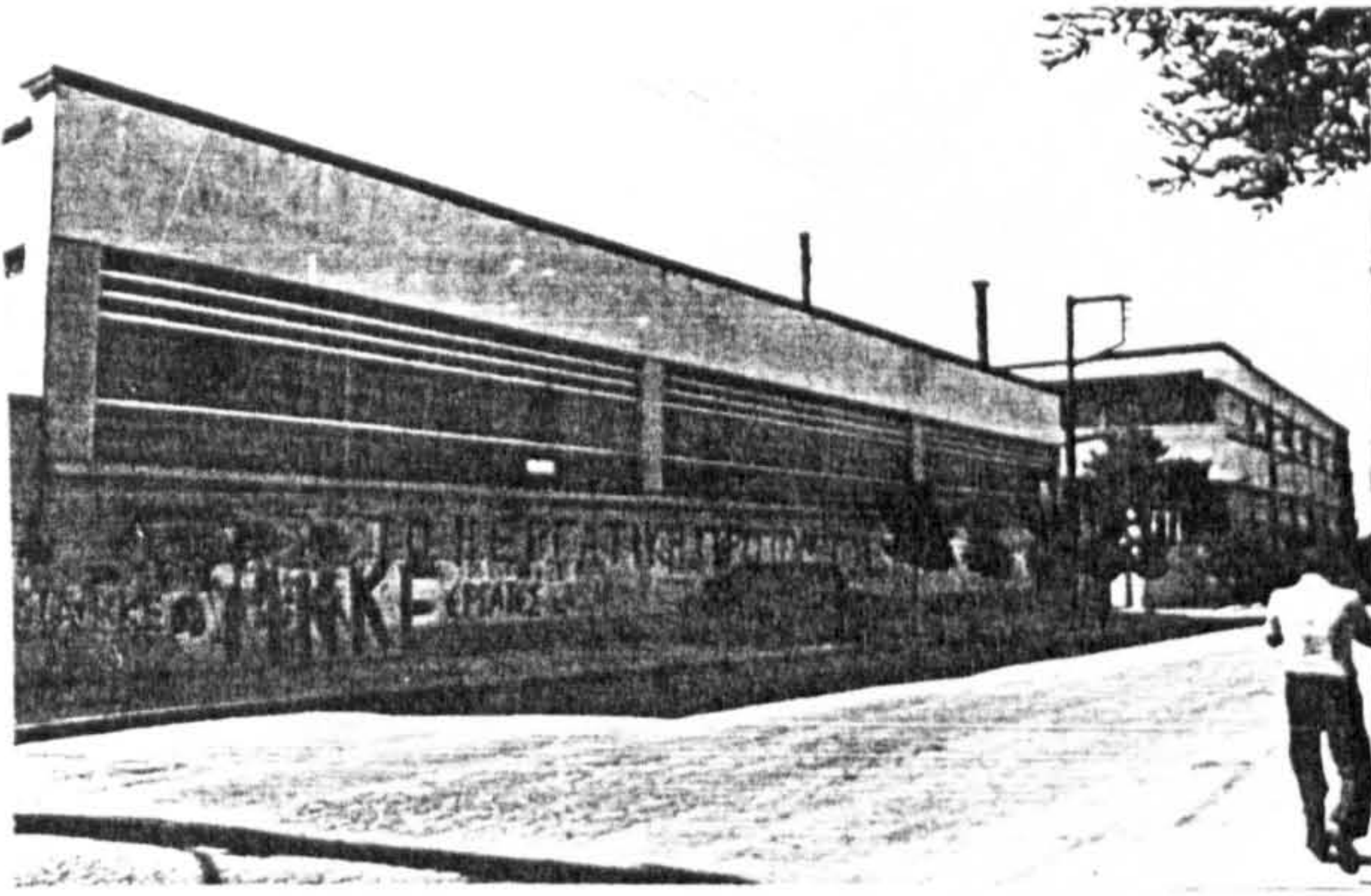


Fig.108. 'Ioniki Ifantourgia'. View from the road, beg. of 50's, (Athens)



Fig.109. 'Ioniki Ifantourgia', beg. of 50's, (Athens)



Fig.110. 'Sacalides, J.' (A.28). On the left with the saw tooth roof is the building used for spinning and warehousing, beg. of 50's, (Athens).



Fig.111. 'Sacalides, J.' (A.28). View of the other building used for spinning, beg. of 50's, (Athens)



Fig.112. 'Piraiiki Patraiki Cotton Manufacturing Co' (A.22). Main entrance. The upper part of the quasi-classical portico is used as a balcony. The pattern of parapet was very common in the bourgeois houses of Athens at that period, c.a. 1947, (M. Pefko).



Fig.113. 'Ioniki Ifantourgia'. A typical unpedimented ionic portico accentuates the entrance, beg. of 50's, (Athens)

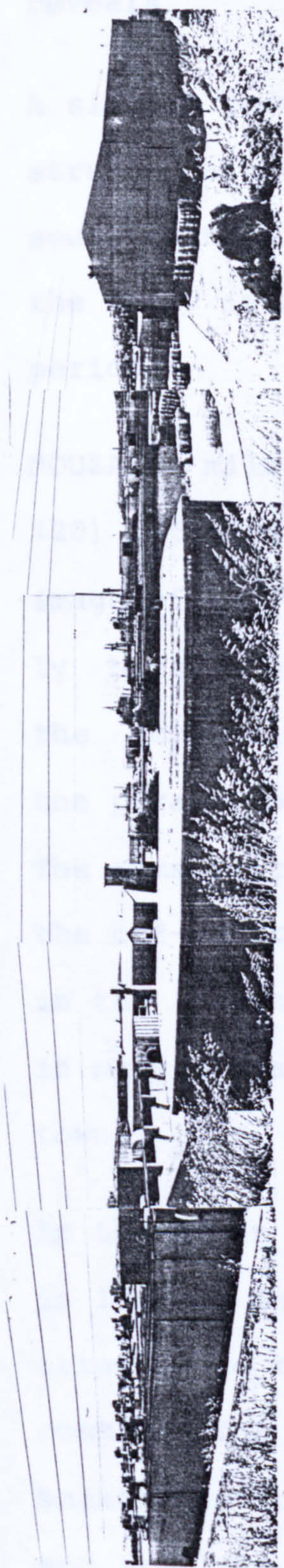


Fig. 116. 'Aegeon Mills' (A.29). View of the back part of the complex, c.a. (1955-1972), (Laurio)

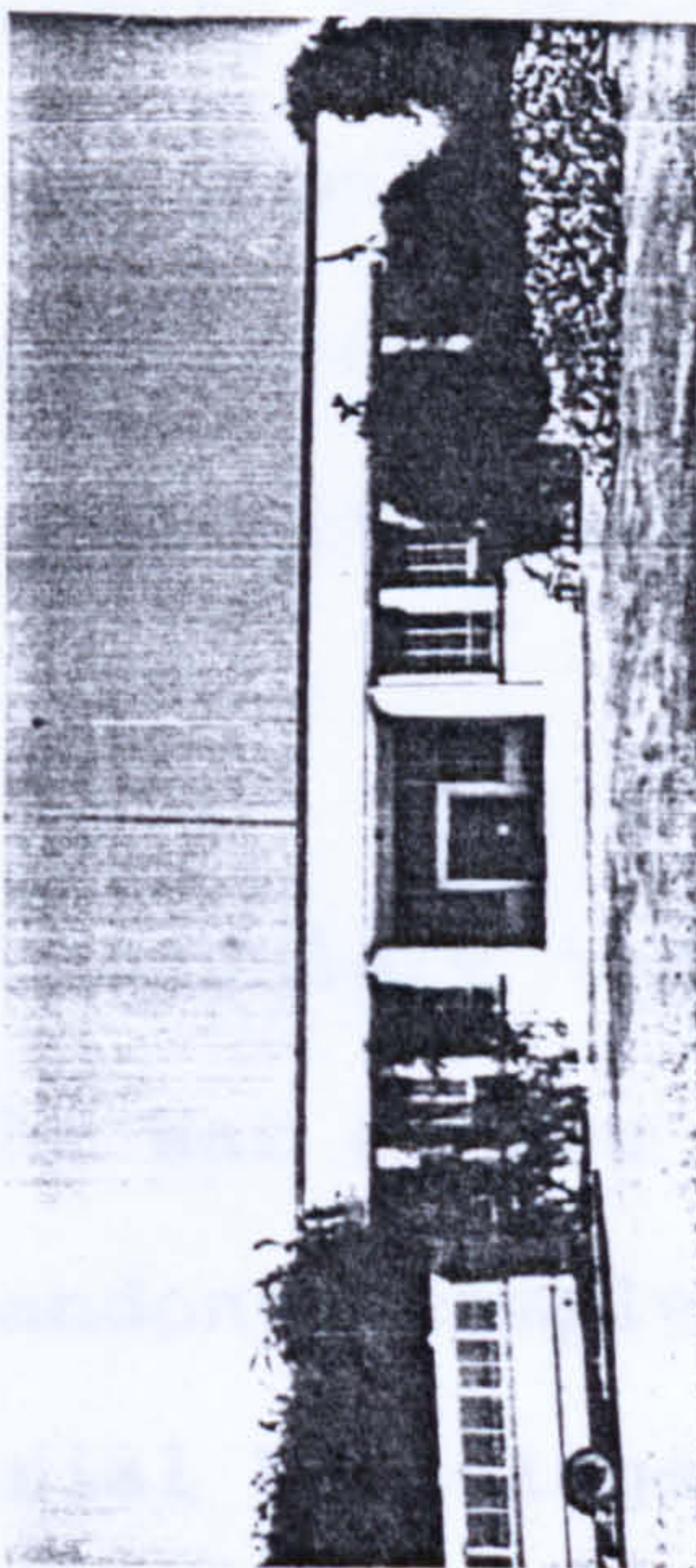


Fig. 114. 'Aegeon Mills' (A.29). The main entrance to the offices shares common formal features with A.Kahn's design of Lady Esther factory (next photograph), c.a. 1955-1972, (Laurio)



Fig. 117. 'Lanaras-Kirtsis Mills'. View of the offices. The manufacturing area is not in use. The offices are used as a shop, 1930's, (Athens)

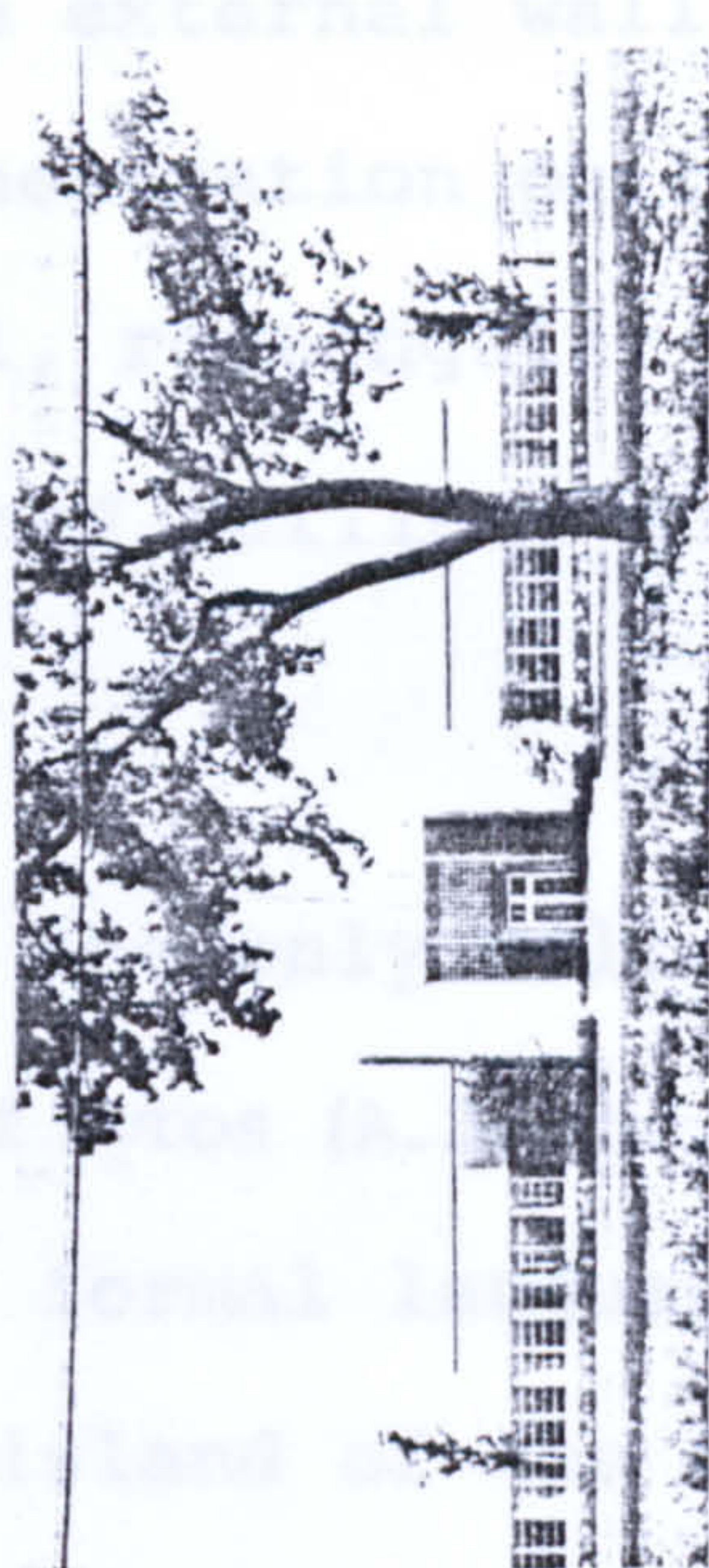


Fig. 115. Factory for Lady Esther. A typical Albert Kahn plant of the mid-thirties.²²

final form by pressure deformation. The external wall is interrupted only by simple incisive fenestration pattern which is repeated in every level: small, rectangular windows in a severe sequence with square-sectioned mullions and deep reveals.

A similar formal vocabulary is used in the only mill constructed after the War on the island of Syros (A.27, fig. 118) which seems to have abandoned completely the formal language of the early industrial buildings of the island of the first period.

MOUZAKIS mill which is next to LANARAS-KIRTSIS (fig. 119, 120) reflects quasi-neoclassical influences. It recalls the image of the office building of OLYMPOS-PELLA (A.10) especially because of the fenestration pattern. The building gives the impression of a flat-topped rectangular volume due to the parapet of the roof which hides the pitched roof behind. The symmetrical articulation of the facade is interrupted by the off-centred entrance which has been recently renovated in the 'kitch' way of the current popular taste expressed in many entrances of cheap residential buildings in Greek towns.

In the other building of the MOUZAKIS firm (fig. 121), which is located on another site, the neoclassical features are attached to the plain facade of an otherwise unarticulated complex. The sequence of quasi-Doric columns on the red background are alien to the formal language of the building and are like scenery superimposed on a cool, unembellished facade.



Fig.118. 'Piraiiki Patraiki Cotton Manufacturing' (A.27), beg. of 50's, (Syros)



Fig.119. General view of 'Mouzakis El.D.' (A.23) on the left and 'Lanaras-Kitsis Mills' on the right, (Athens)



Fig.120. 'Mouzakis El.D.' (A.23). View of the offices, 1940's, (Athens)



Fig.121. 'Mouzakis El.D.', 1960's, (Athens)

Two other buildings (A.24, A.25) constructed during the 50's have undergone so many changes that any single architectural character can hardly be distinguished. Their main facades reveal some signs of early Modernism (fig. 122, 124).

The 60's witnesses the emergence of the large windowless building. We can distinguish two basic categories of buildings concerning the treatment of the framing system as a part of the formal vocabulary. In the first, to which the majority of mills belong, the columns and beams are exposed on the facade. Thus, their formal composition is based on the contrast between load bearing frame and infill elements. This is achieved with their different colouring and the construction of the outer walls slightly inside the external columns of the frame (fig. 126.-135). The offices usually are designed in a similar way. When they are incorporated within the factory enclosure on a mezzanine floor, their position is emphasized on the facade by their windows. When the administration building is attached to the production hall it is formally harmonized with the overall aesthetic of the factory volume (fig. 136-139). In most of the cases the office buildings are monotonous, oblong, rectangular volumes.

An exceptional and inconspicuous building is the offices of the firm SOURNOPOULOS (fig. 140, 141) which despite the fact that it employs the same formal principles of the manufacturing block, avoids the monotonous impression. The curved balconies, the glass curtain wall of the entrance which is set back behind the surface of the facade, the large



Fig.122. 'Athina Spinning Weaving' (A.24). View of the main facade. The offices are on the first floor, 1940's, (Athens)



Fig.123. 'Athina Spinning Weaving' (A.24). View of the side part of the building, 1940's, (Athens)

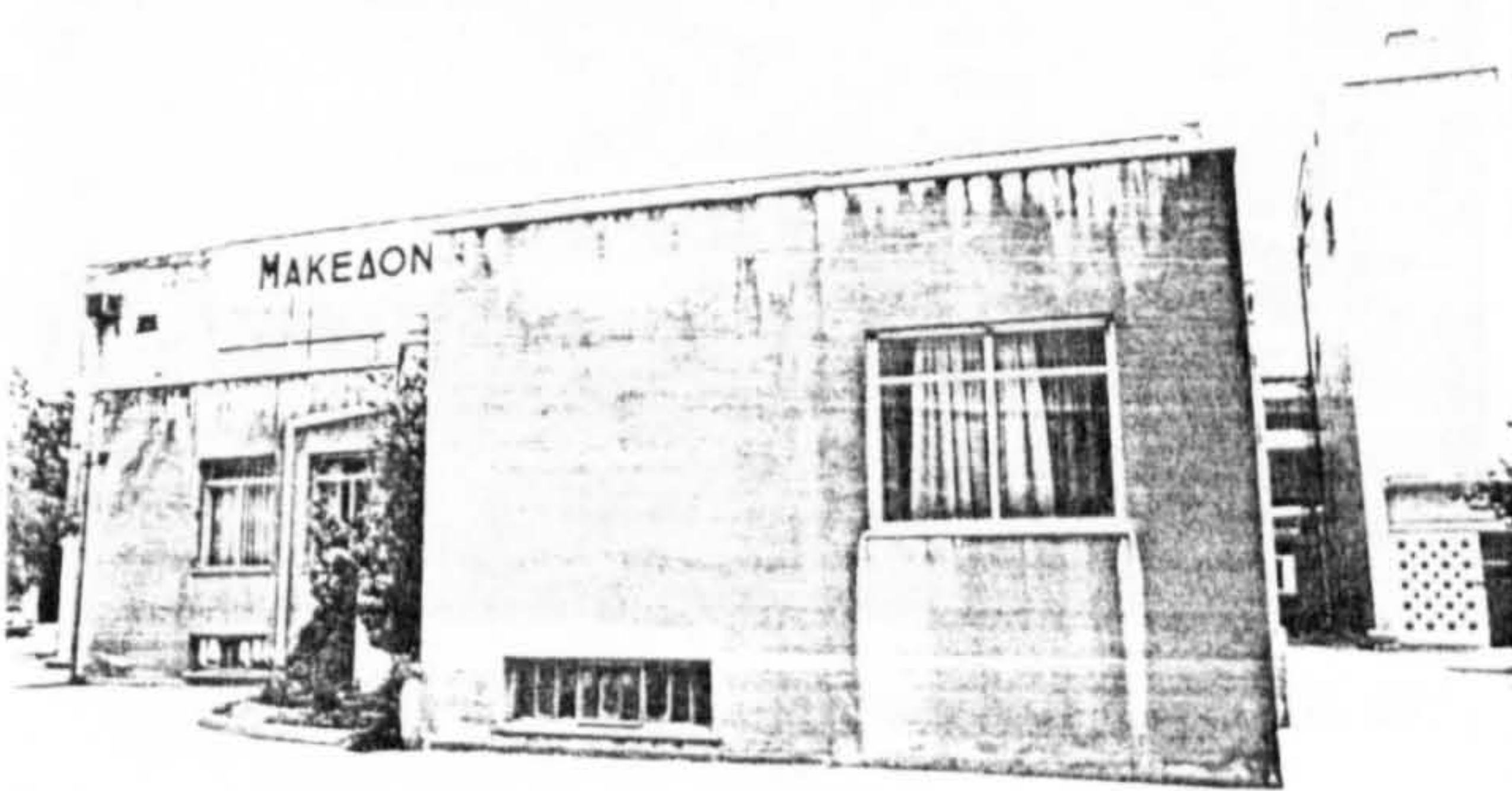


Fig.124. 'Macedonian Spinning Mills' (A.25). View of the administration building, end. of 40's, (Athens)



Fig.125. 'Macedonian Spinning Mills' (A.25). View of the factory, end. of 40's, (Athens)



Fig.126. 'Ilios Textile C.S.Constantinides' (A.33). View of the dyeing department, 1968-1970's, (Thessaloniki)



Fig.127. 'Ilios Textile C.S.Constantinides' (A.33). View of the weaving department. A plain surface without openings is interrupted by the sequence of columns, 1968-1970's, (Thessaloniki)

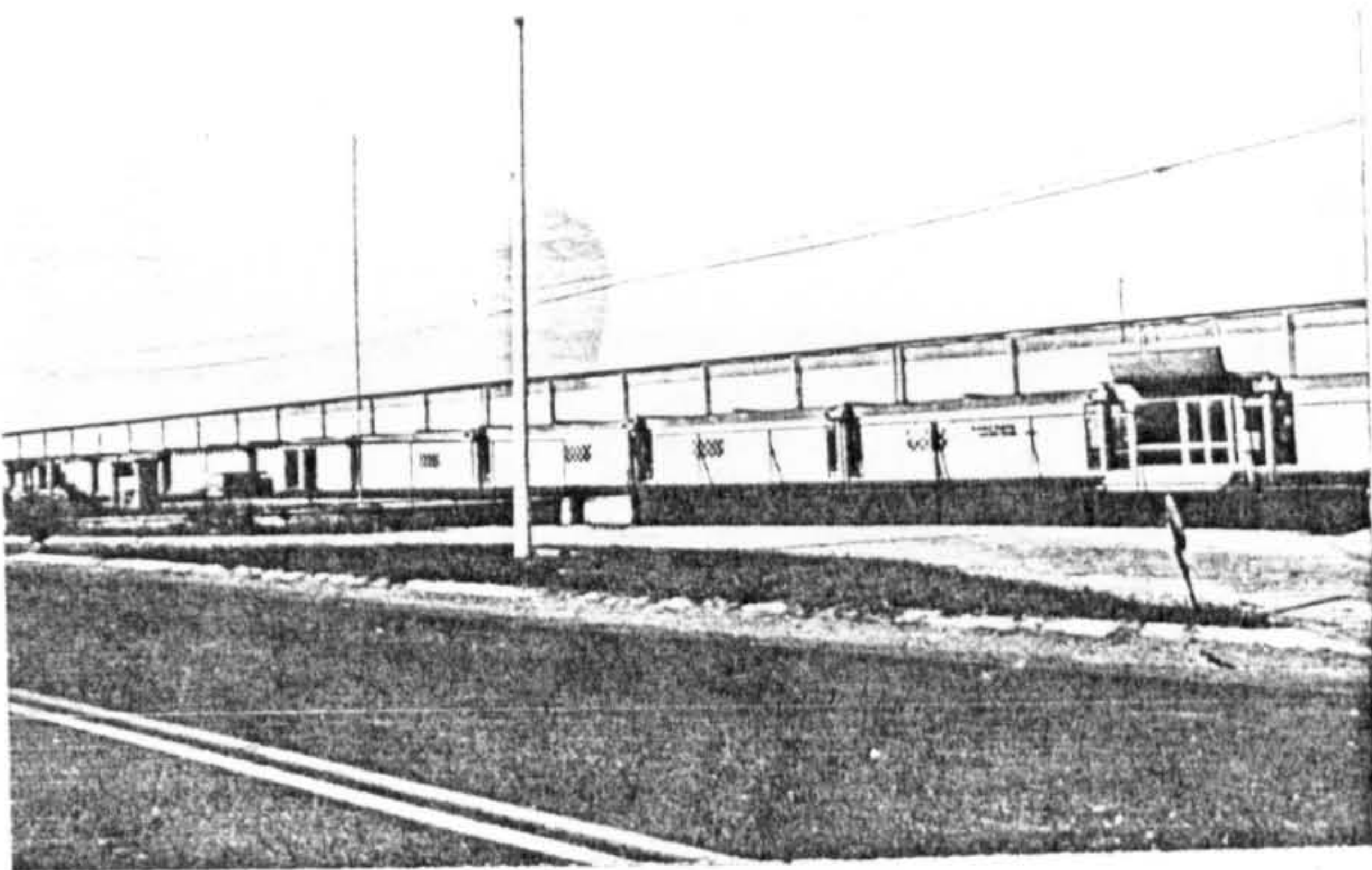


Fig.128. 'Naoussa Spinning Mills' No 2 (A.30). The factory is outlined in the background behind the lower building which includes offices and auxiliary facilities, beg. of 60's, (Naoussa)

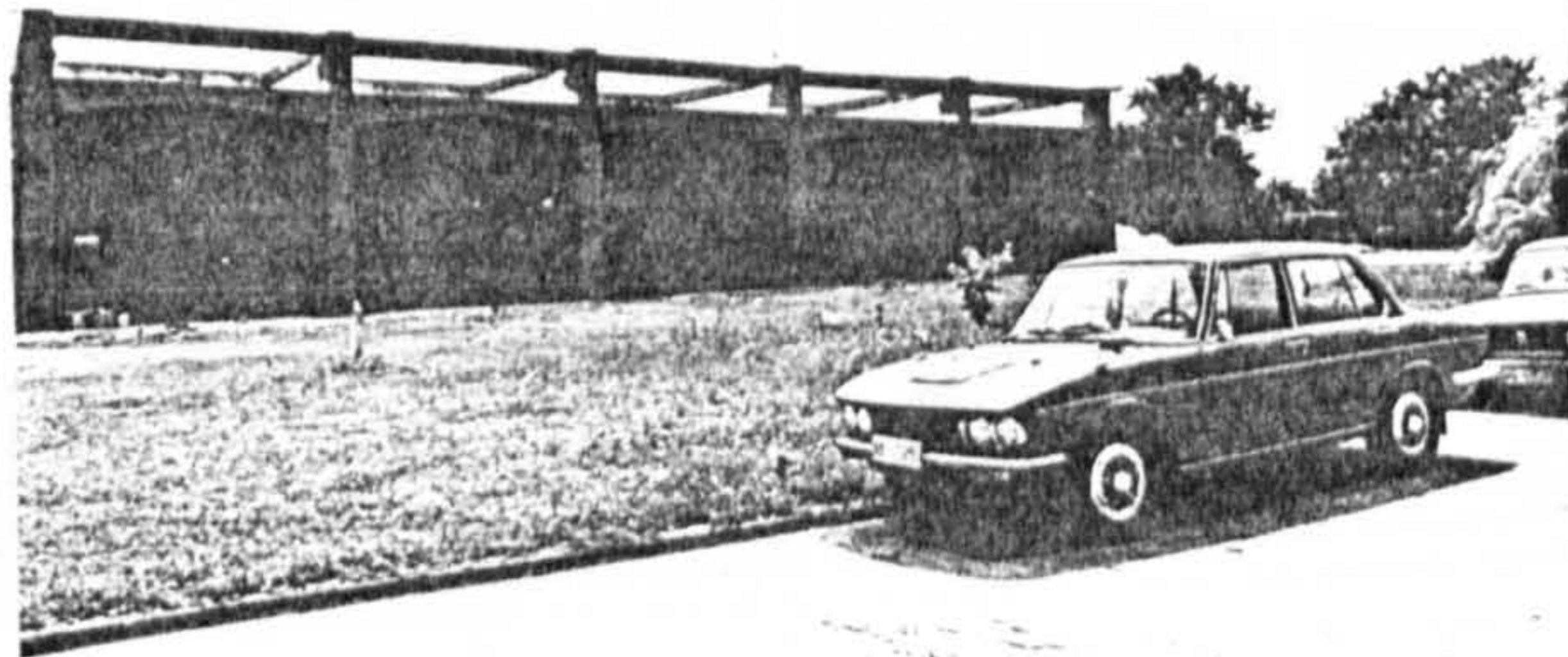


Fig.129. 'Naoussa Spinning Mills' No 3 (A.31). View of the building used for warehousing the final product. The volume is carried by inverted beams, beg. of 60's, (Naoussa)

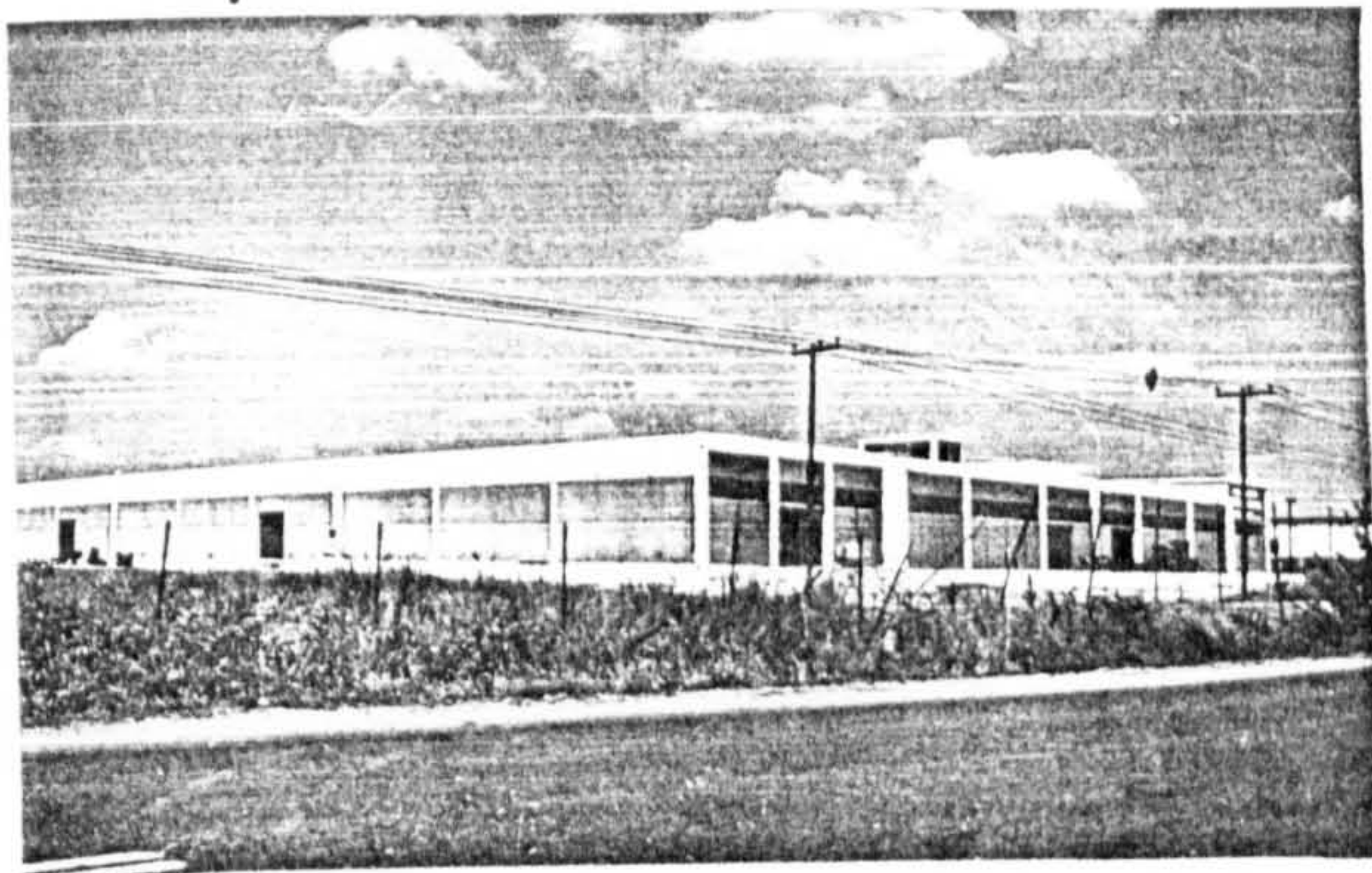


Fig.130. 'Hellenic Pella Spinning Mills' (A.49), c.a. 1973, (Pella)

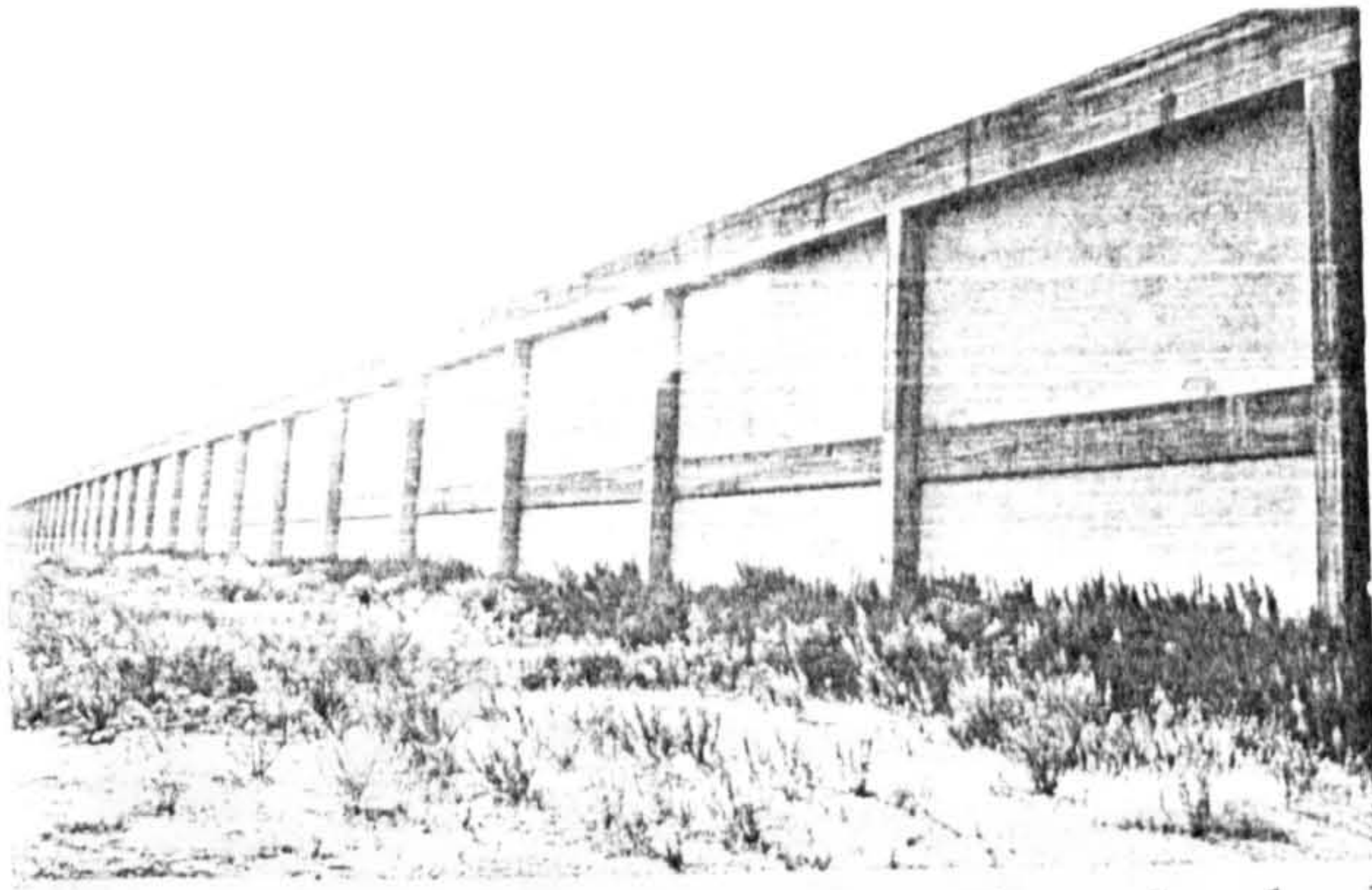


Fig.131. 'Kriticos H.G.' (A.55) Dull, cool, closed oblong building, end of 70's, (Patra)

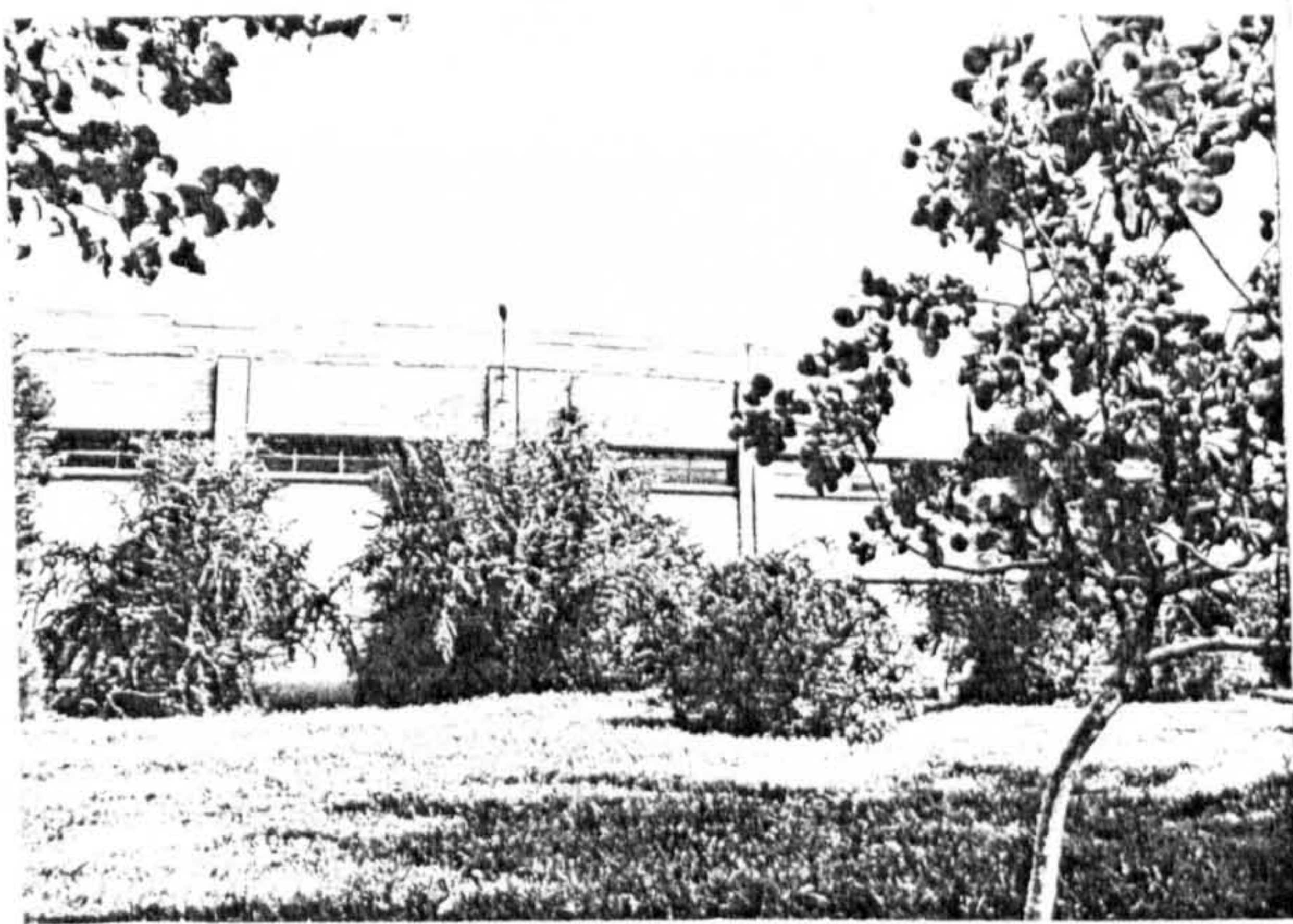


Fig.132. 'Sourmopoulos' (A.44). View of a part of the factory, c.a. 1972, (Thessaloniki)



Fig.133. 'Stickerei G.Poulitsidis' (A.35), end of 60's, (Thessaloniki)

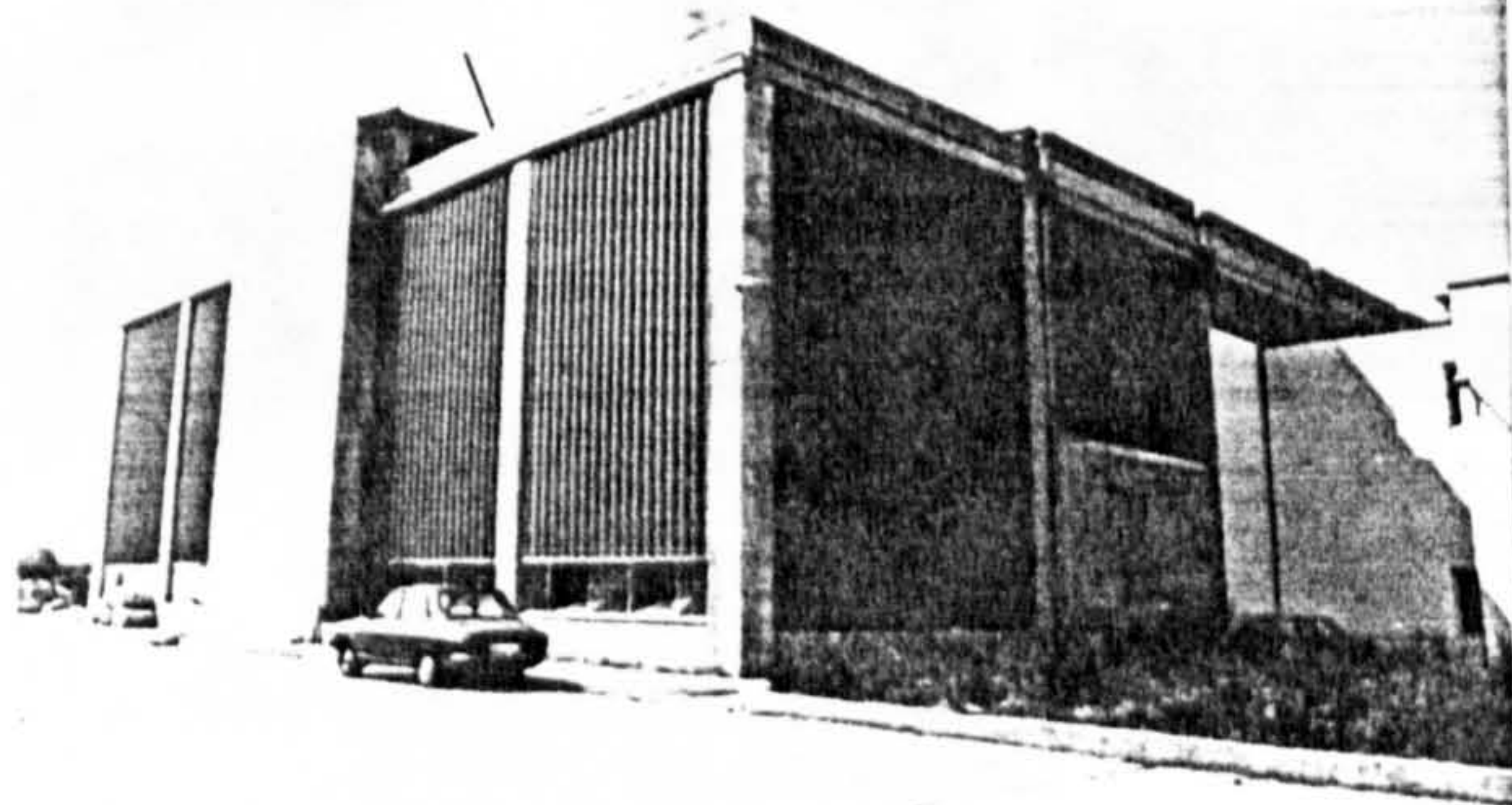


Fig.134. 'Verlan' (A.57), c.a. 1979, (Region of Pella)



Fig.135. 'Varvaressos Greg. & Co Naoussa Spinning Mills' (A.32), c.a. 1964, (Naoussa)



Fig.136. 'Ilios Textile C.S. Constantinides' (A.33). View of the administration building, 1968-1970's, (Thessaloniki)

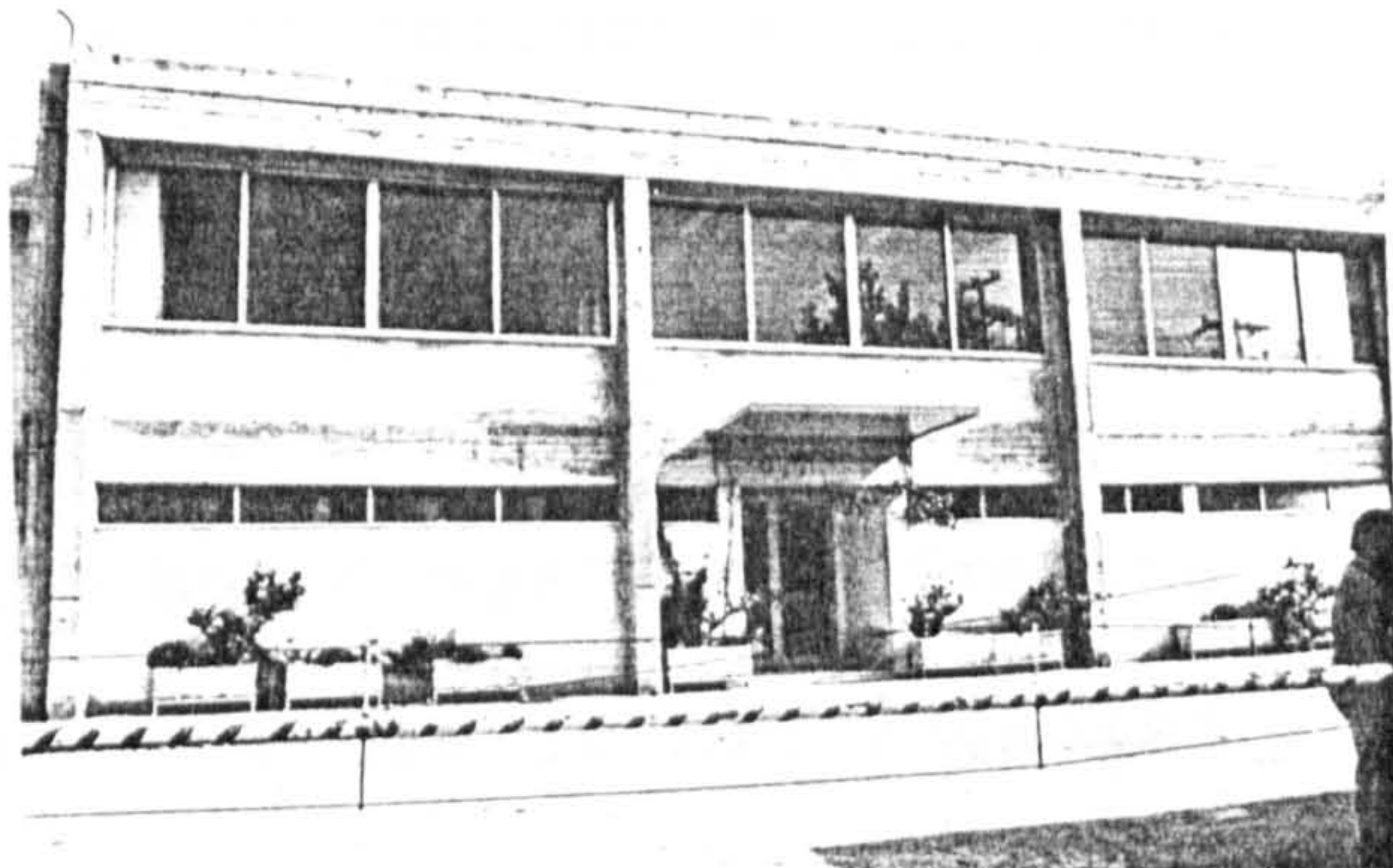


Fig.137. 'Kriticos H.G.' (A.55). Office building, end of 70's, (Patra)

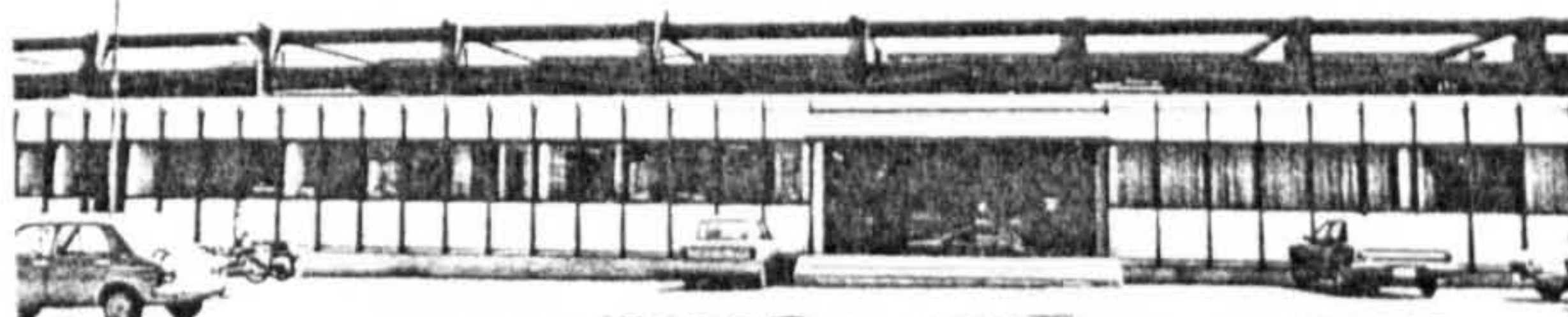


Fig.138. 'Naoussa Spinning Mills' No 3 (A.31). Office building. The framing system is sheathed with the curtain wall construction, beg. of 60's, (Naoussa)



Fig.139. 'Verlan' (A.57). In the foreground is the office building. The load bearing elements are not exposed on the facade. The white plain rectangular volume is interrupted only by accentuated architraves of the windows, c.a. 1979, (Region of Pella)



Fig.140. 'Sournopoulos' (A.44). Office building, c.a.1972, (Thessaloniki)



Fig.141. 'Sournopoulos' (A.44). The entrance to the office building, c.a. 1972, (Thessaloniki)

canopy and the interesting interplay of colours - light grey, white, red and deep blue - give the whole a delicate character.

The second category includes those buildings whose framing system are on the inside and the structure is not revealed on the facades or at least is disclosed only partially. In the latter case the upper beam of the structure with the roof parapet are exposed on the elevation and constitute a linear horizontal element which terminates the volume (fig. 142). The columns are either embodied in the wall's construction or concealed behind a continuous surface of corrugated panels, prefabricated concrete slabs or curtain walls (fig. 143). The offices are always included in the factory volume as a mezzanine floor usually above the entrance to the building. Their position is differentiated from the rest of the ancillary facilities due to the large glass surfaces.

A notable example of this category is the new premises of VETLANS NAOUSSA (fig. 144, 145). The sequence of the gable roofs is used as a compositional element of the facades probably to follow a similar pattern to that of the only remaining part of the old factory. The deep grey colour is used to emphasize the bounding lines of the spatial volume, the gable roofs and the openings. In addition, concrete grey louvres are used as to provide solar protection, when they are constructed horizontally, or as decorative elements, when they are placed vertically to emphasize the dispatch areas.



Fig.142. 'Ilios Ten-Cate Textile Mills' (A.36).
View of a part of the main facade
showing the glass wall of the offices
and the entrance between the air-con-
ditioning terminal units, c.a. 1966,
(Thessaloniki)



Fig.143. 'Aegeon Mills' (A.42), beg. of '70's,
(Nafplio)

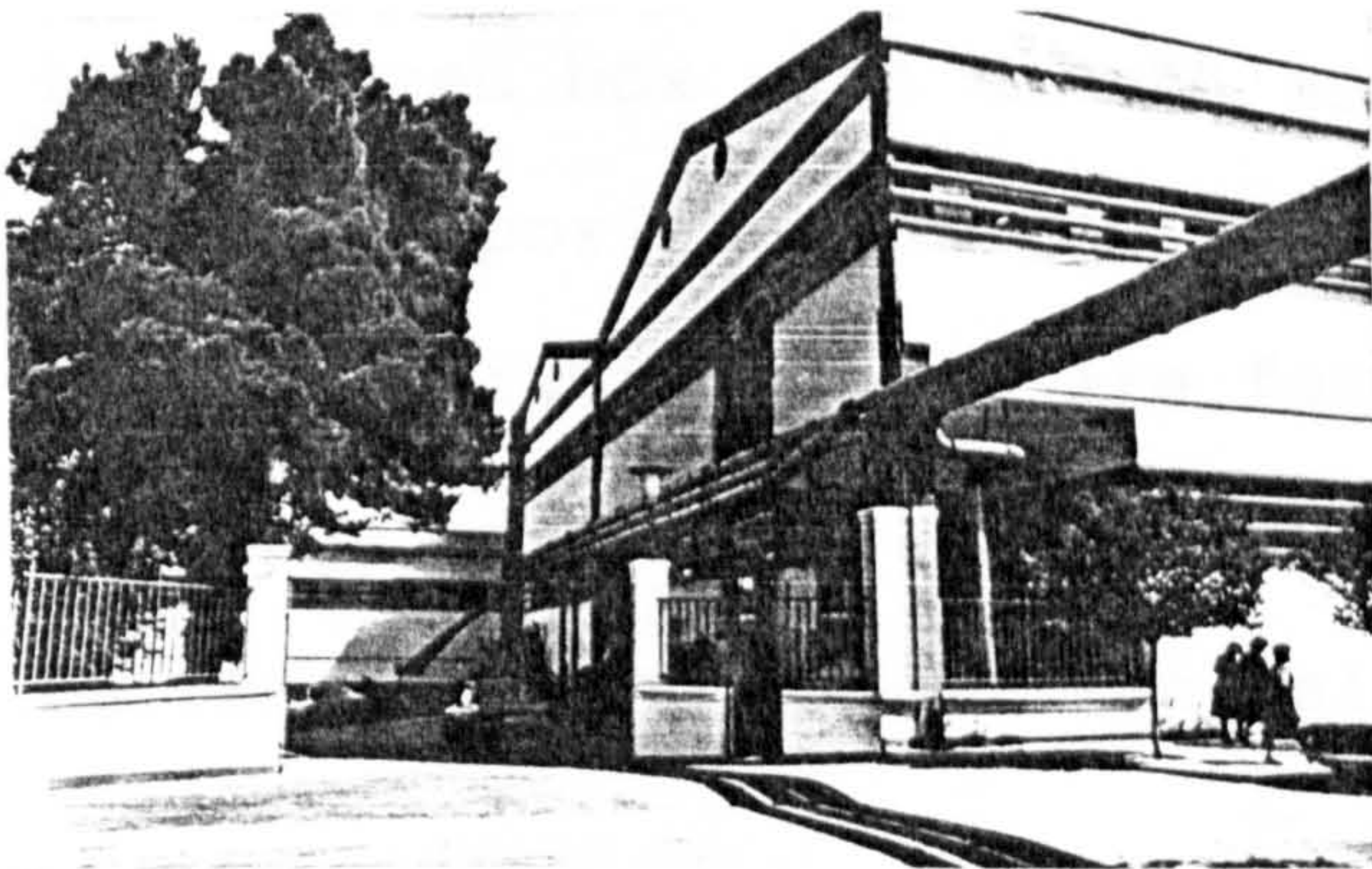


Fig.144. 'Vetlans Naoussa Spinning & Weaving
Mills' (A.52), end. of 60's, (Naoussa)

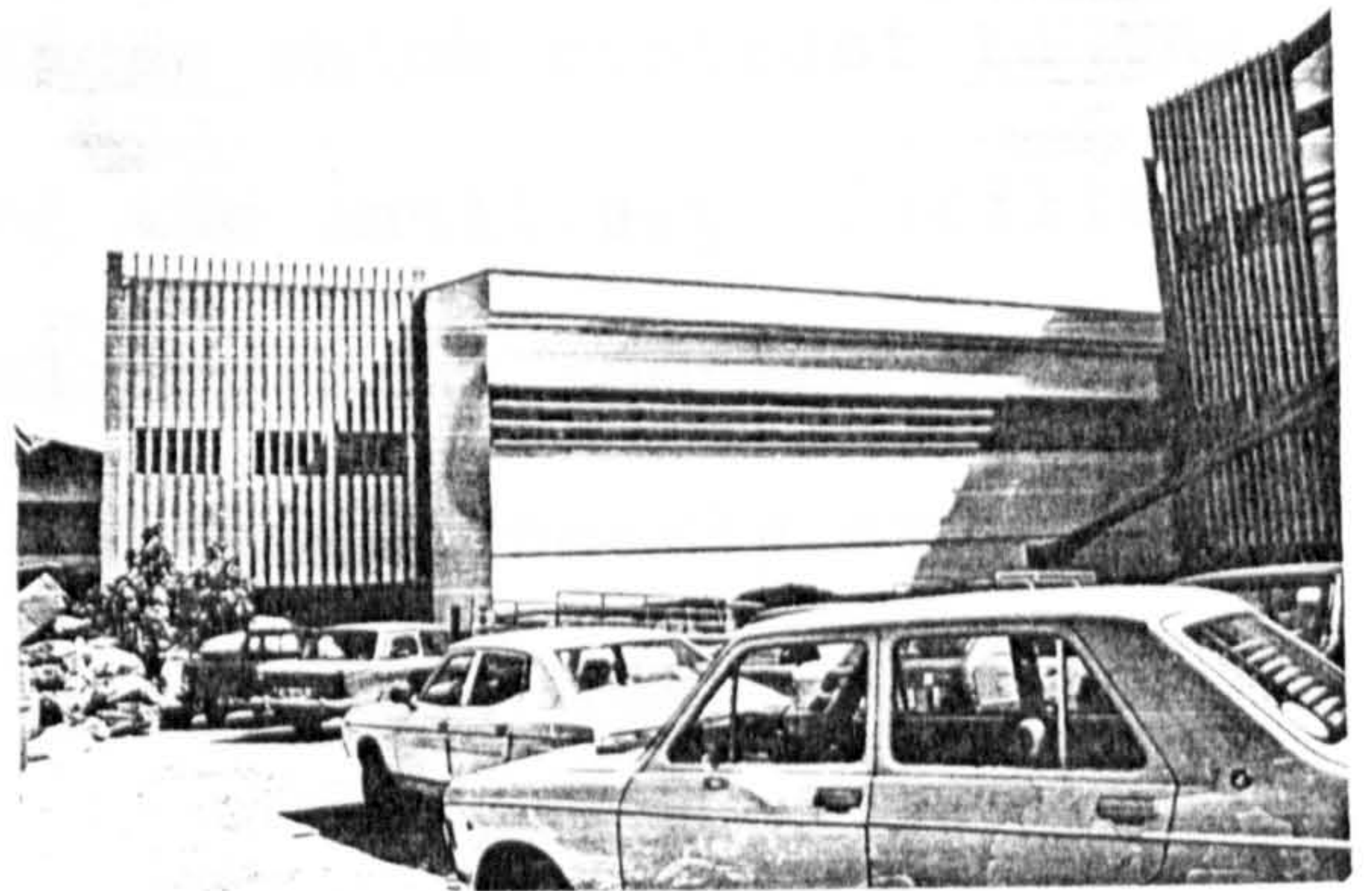


Fig.145. 'Vetlans Naoussa Spinning & Weaving
Mills' (A.52). View from the court-
yard, end. of 60's, (Naoussa)

The complex would be consistent in its general formal principles without its office building (fig. 146). The architect was asked by the owners of the firm, which is one of the oldest of the area, to design a building identical to a traditional Macedonian house. The designer tried to reconcile the present needs of the administration with the required traditional form. However, the result does not have the delicacy of the houses of the area. After the first impression of the facades some details betray inconsistency: the non load bearing wooden columns of the portico with their pseudo wooden capitals reveal their decorative function, the structural frame system appears as massive, the construction and details of the eaves are heavy.

There are only two mills where the framing system is not exposed on the elevation (A.46, A.47). The production hall is a closed box with smooth surfaces which contrast to the formal composition of the zone of the ancillary facilities and the offices. These are formulated as a complex of small rectangular volumes with ribbon windows linearly extended in front of the production hall (fig. 147, 148).

Finally, in one case, the characteristics of the two categories are combined (A.45). The structural frame is not exposed in one of the facades, whereas it is revealed in the other. The complex is a combination of two rectangular volumes - one closed and one transparent - tightly articulated with the concrete horizontal ducts of the air conditioning which run vertically along the top of the volume.



Fig. 147. 'Preveza Mills' (A.46), c.a. 1973, (Preveza) **23**



Fig. 148. 'Pitraiki Patraiki Cotton Manufacturing' (A.47), c.a. 1980, (Karpenisi) **24**



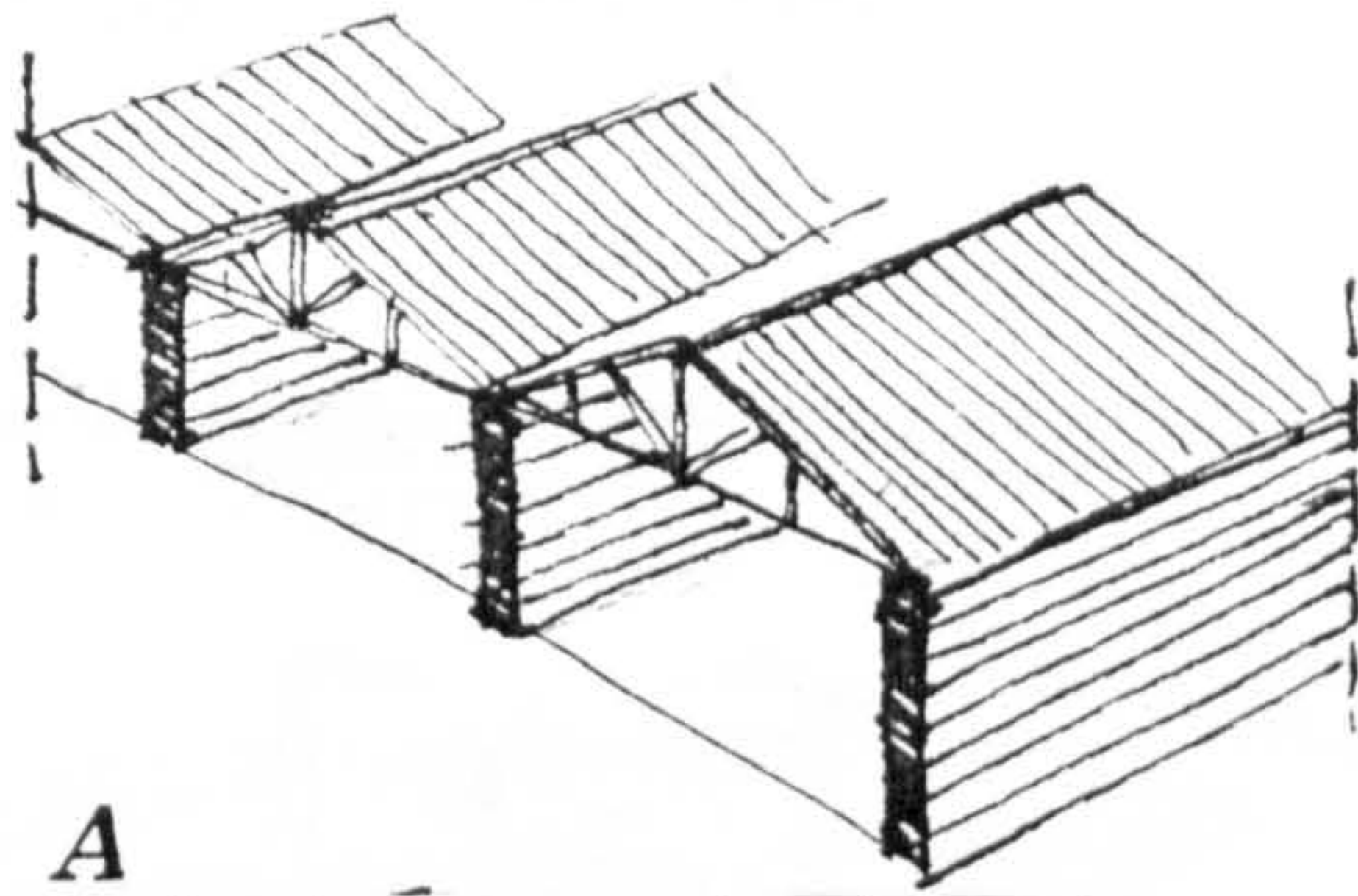
Fig. 146. 'Vetlans Naoussa Spinning & Weaving Mills' (A.52). View of the office building, end. of '60's, (Naoussa)

A common feature of all the buildings with an internal framing system is the use of the cubic volumes of the terminal air-conditioning units as fundamental parts of their formal vocabulary. These impressive, vertically projected concrete cubes without openings appear in a sequence in the main facade, they interrupt the linearity of the volume and relieve the image of an otherwise monotonous, plain, oblong building.

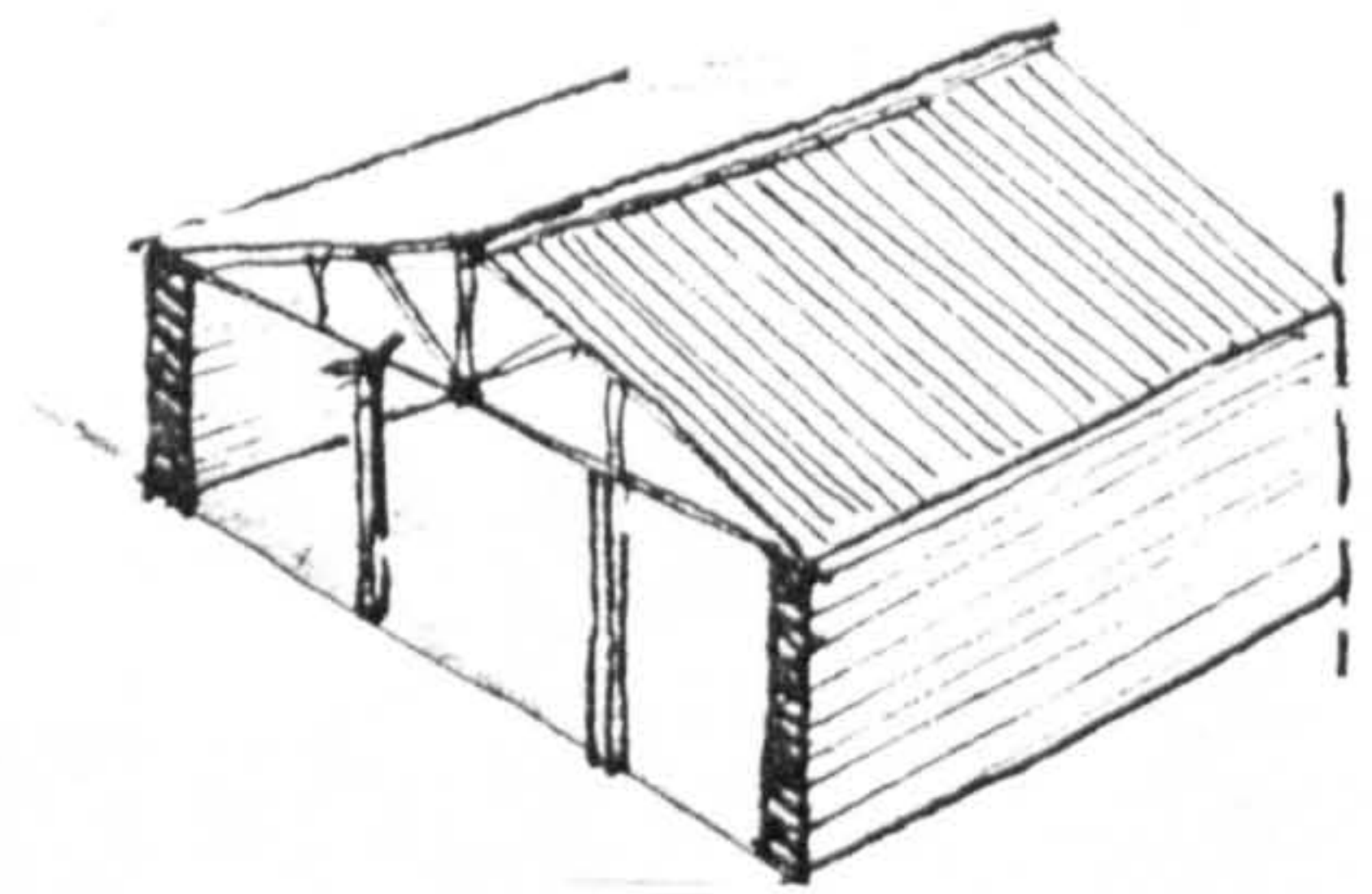
Constructional System

The framing systems of the first mills are combinations of wooden trusses or saw tooth roofs with wooden or steel columns. The buildings are usually single-storey with single span trusses resting on side walls or columns in the walls, and one or more lines of internal columns. The variety of systems which are used in single and double-storey buildings is illustrated in fig. 149.

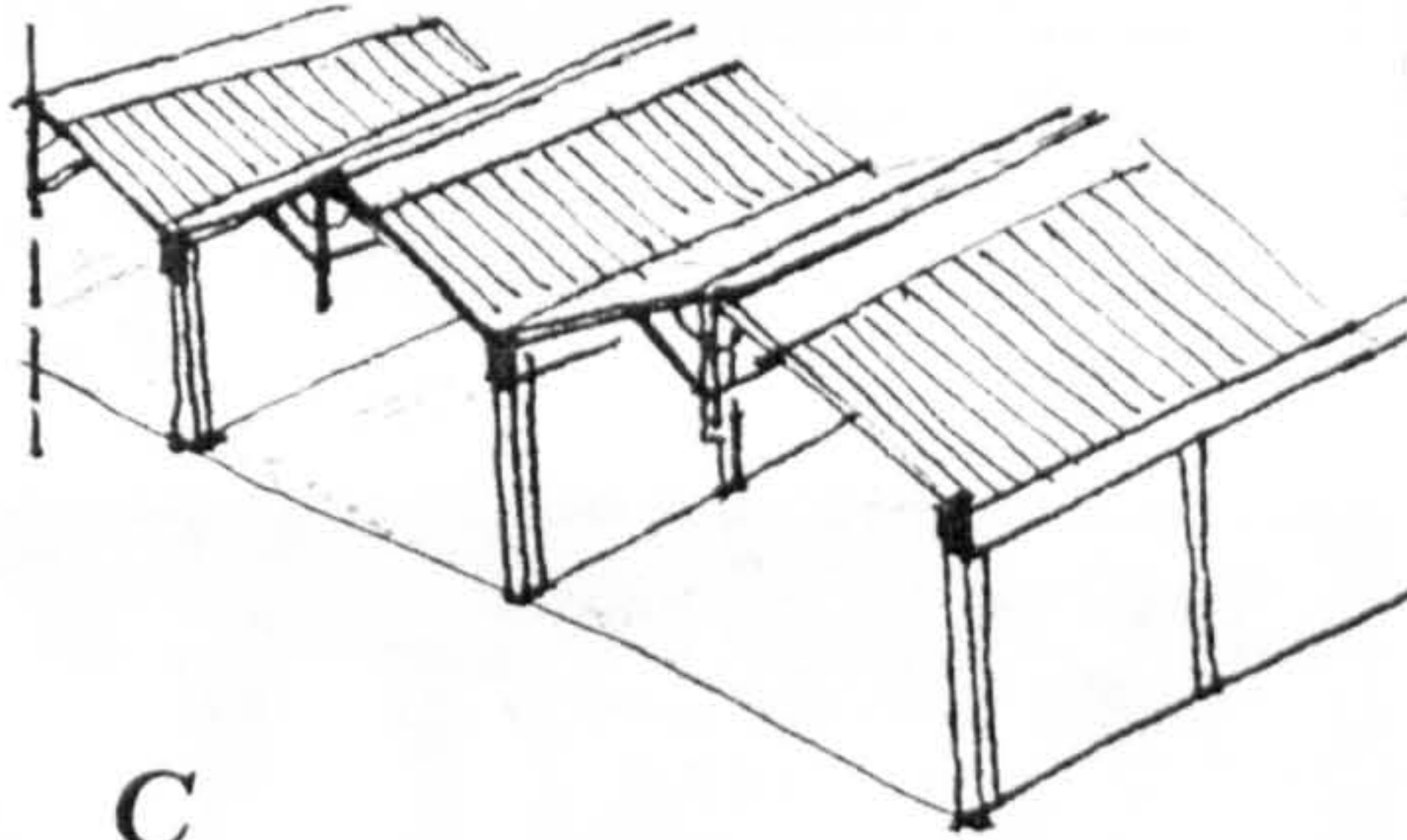
A slightly different wooden roof-hipped instead of gabled-covers the multi-storey building of NAOUSSA SPINNING MILLS (A.9 and fig 150) and the mill of PROTOPAPAS (fig. 151) in Piraeus. The external walls are made of stone and are covered mainly with white stucco. In the double-storey mills of IFEN (A.6), BARBETAS (A.8) and AEGEON (A.5) the bearing walls of the ground floor remain unplastered (fig. 156, 162, 165). This particular manipulation of materials is the result of the intention to apply traditional methods of construction and forms of the areas.



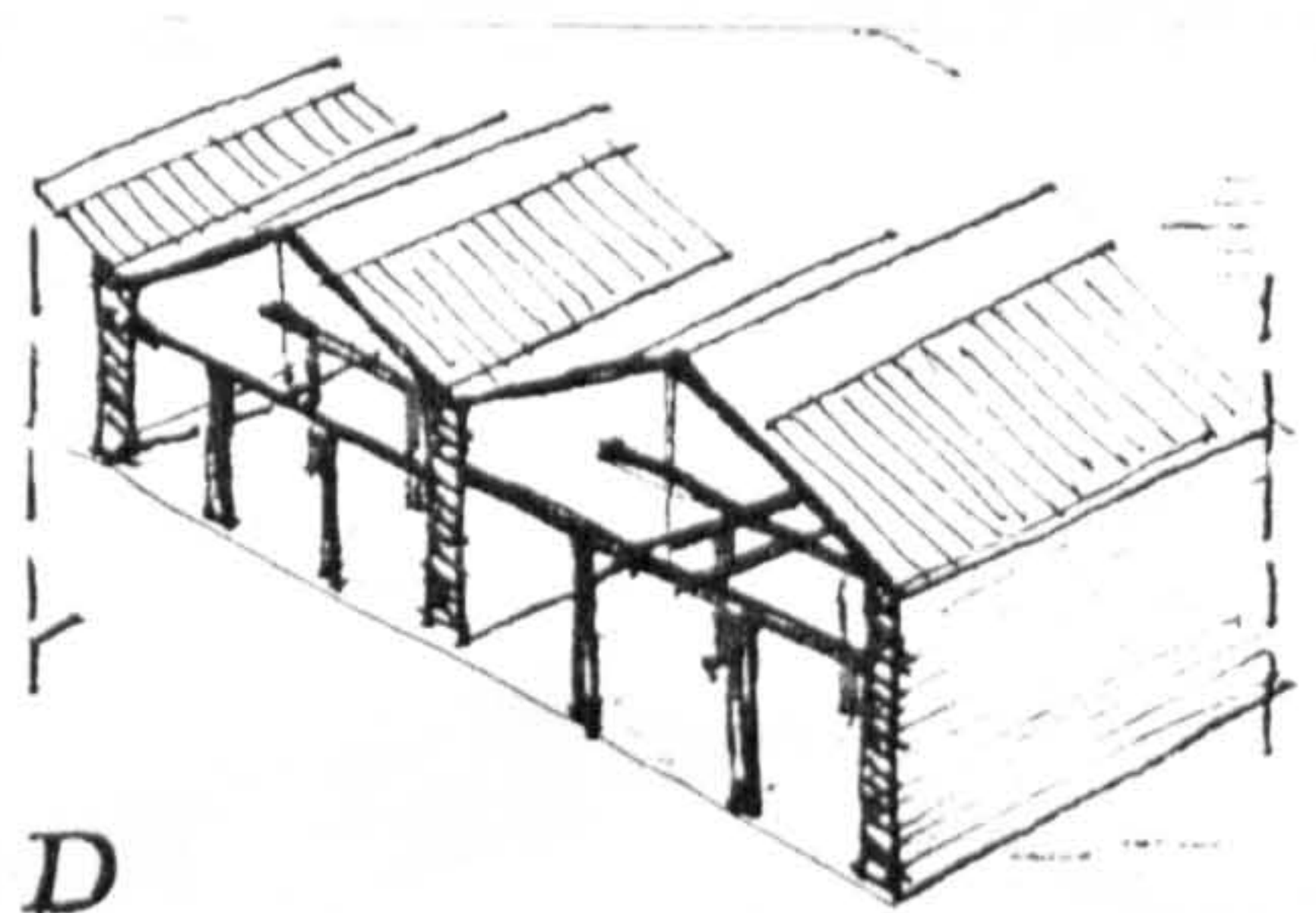
A
Wooden trusses on load bearing stone walls



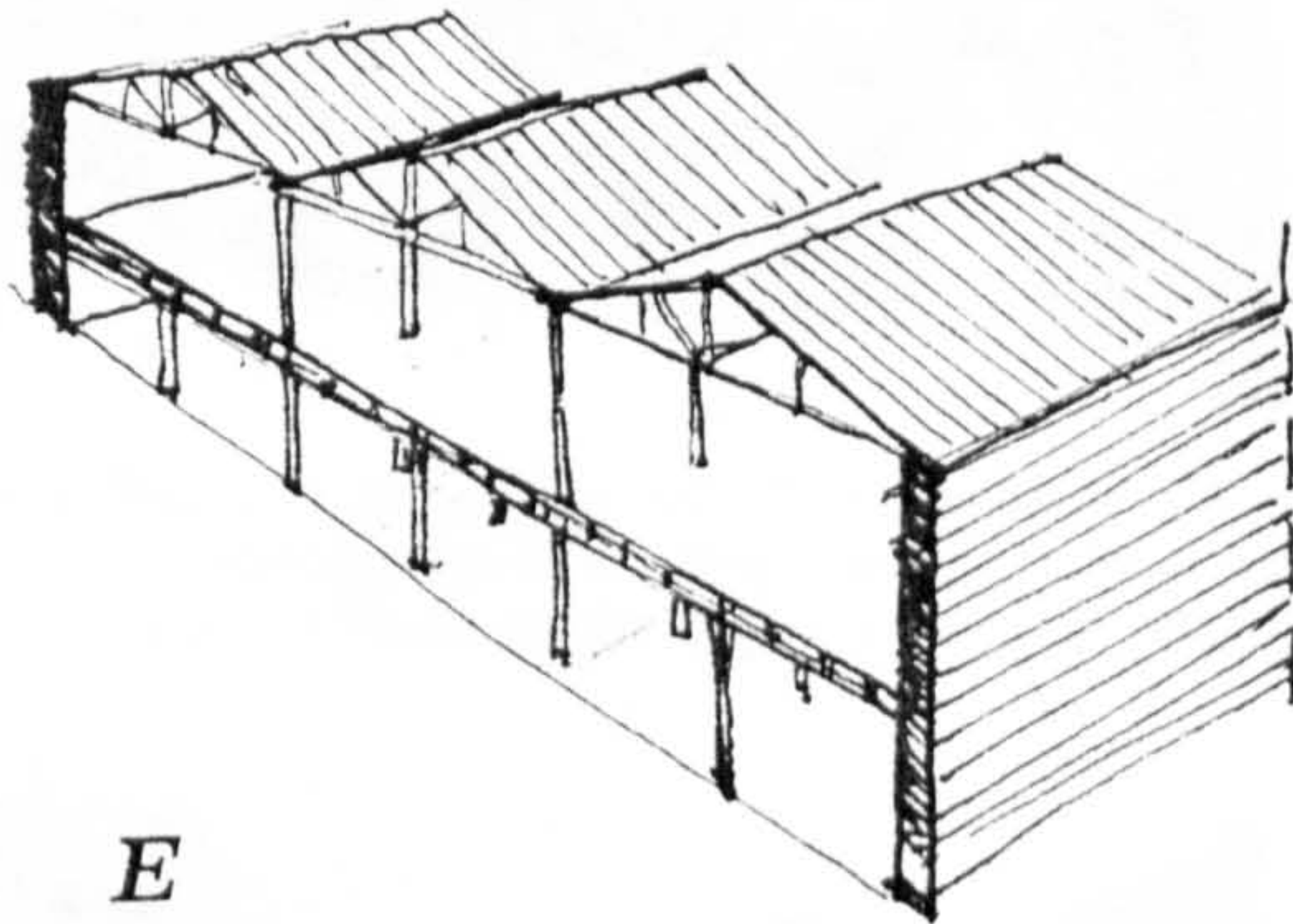
B
Wooden trusses on load bearing stone walls with or without interior wooden columns



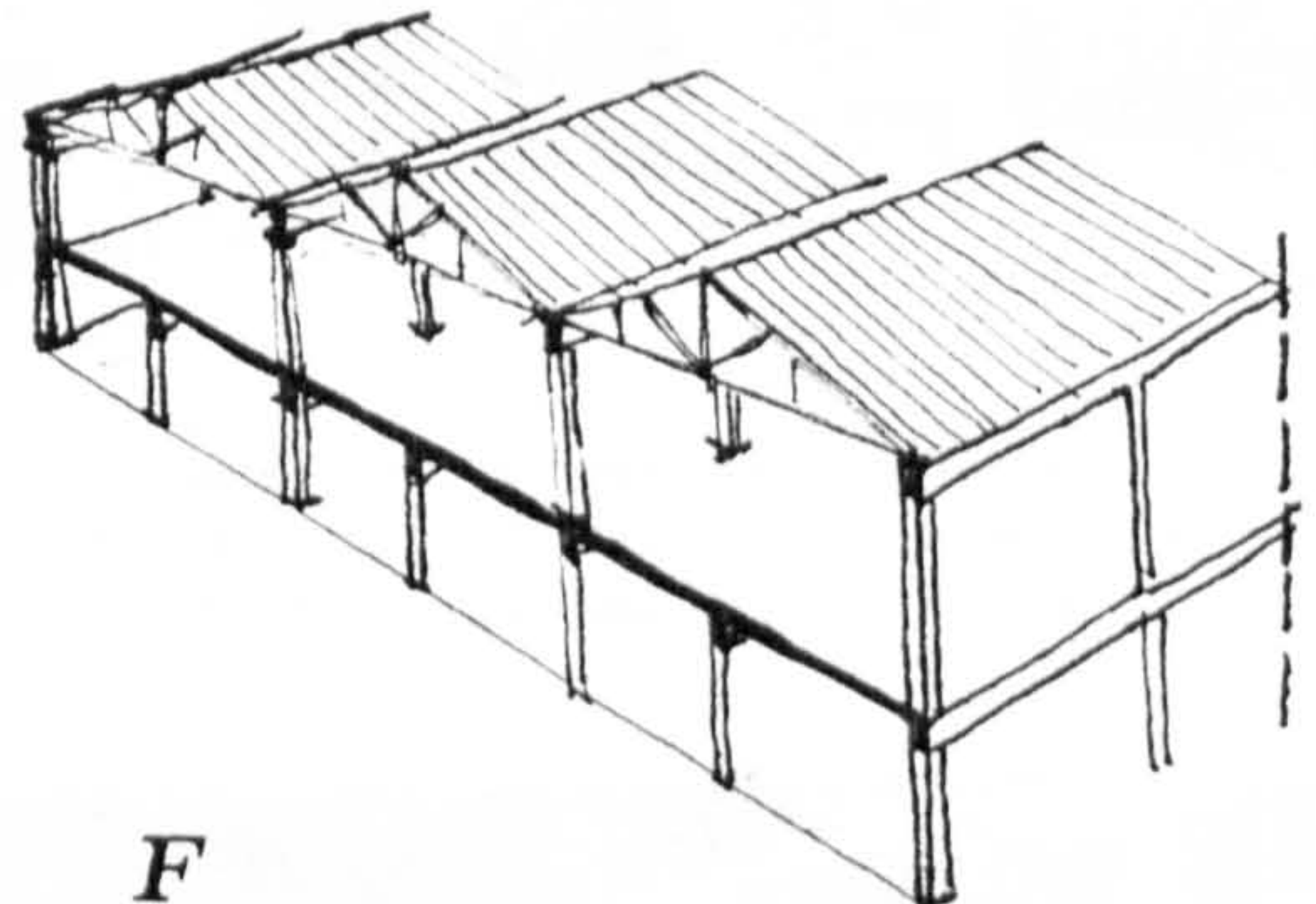
C
Wooden trusses in concrete columns



D
Steel trusses in combination with round iron columns



E
Wooden trusses on load bearing walls. Wooden interior construction



F
Wooden trusses with concrete framing system

Fig.149



Fig.150. 'Naoussa Spinning Mills' No 1 (A.9), c.a. 1928, (Naoussa) **25**



Fig.151. 'Protopapas, G. & Eros', bet. 1900 and 1906, (Piraeus)

Examples of Gabled and Hipped Roofs

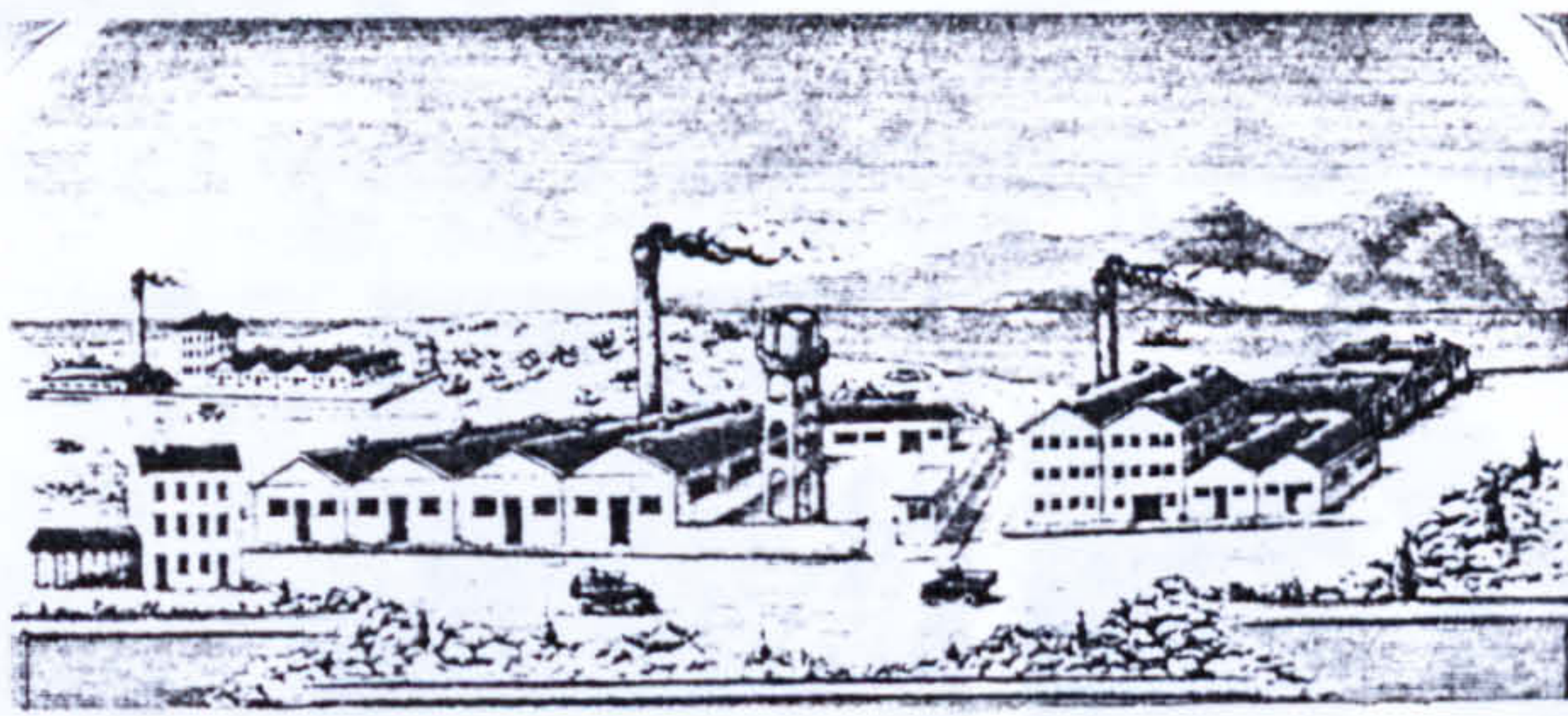


Fig. 152. 'Piraiki Patraiki Cotton Manufacturing'. The first premises of the firm which have been demolished, c.a. 1933, (Patra) ²⁶

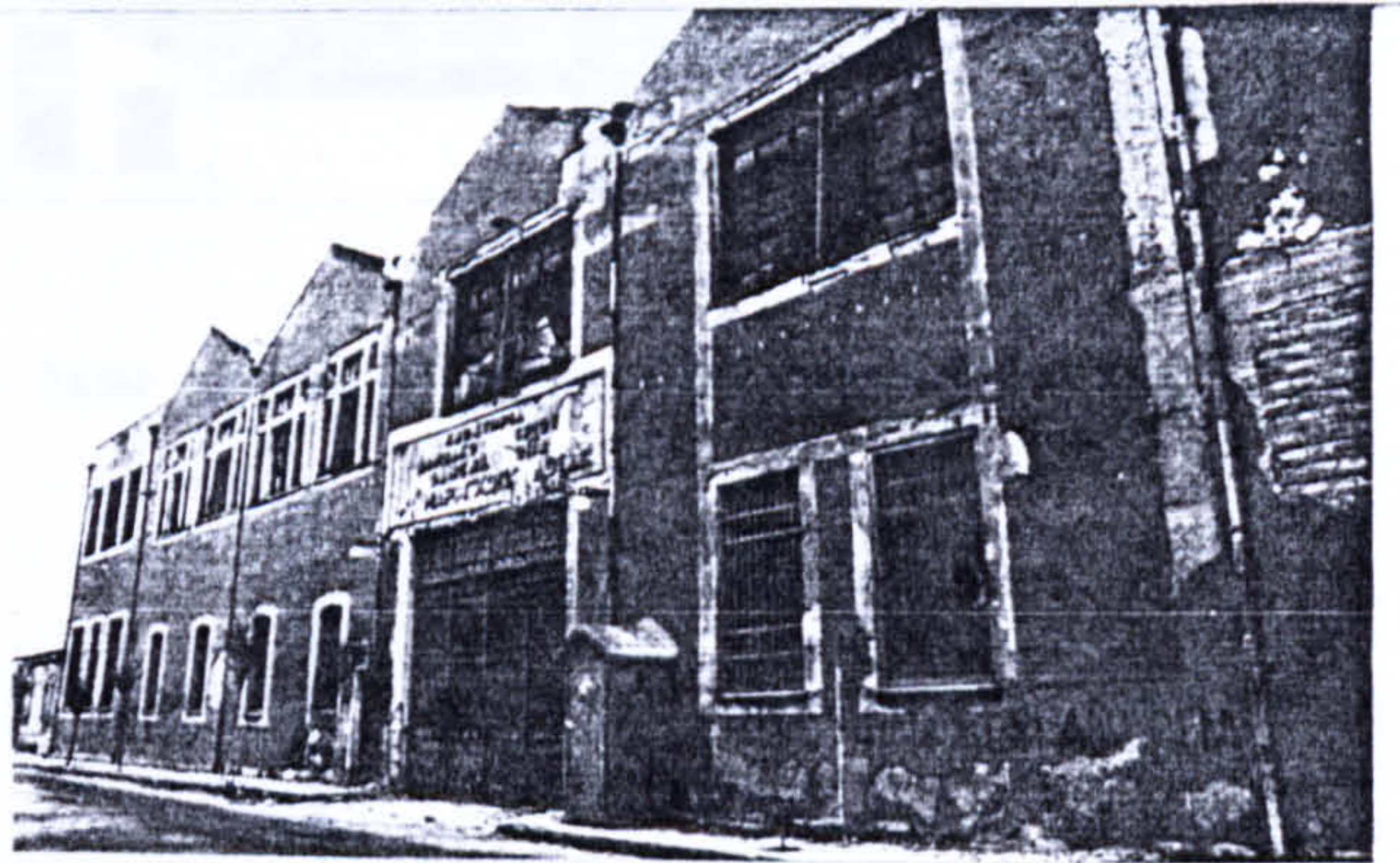


Fig. 153. 'Maragopoulos' old mill in Patra. It is not in use, c.a. 1927



Fig. 154-155. The old building of 'Varvaressos' (A. 32) in Naoussa in the background of the traditional photograph. ²⁷ The building has been demolished but the only remaining part of it is illustrated in the second photograph showing the gabled roof, 1920's, (Naoussa)

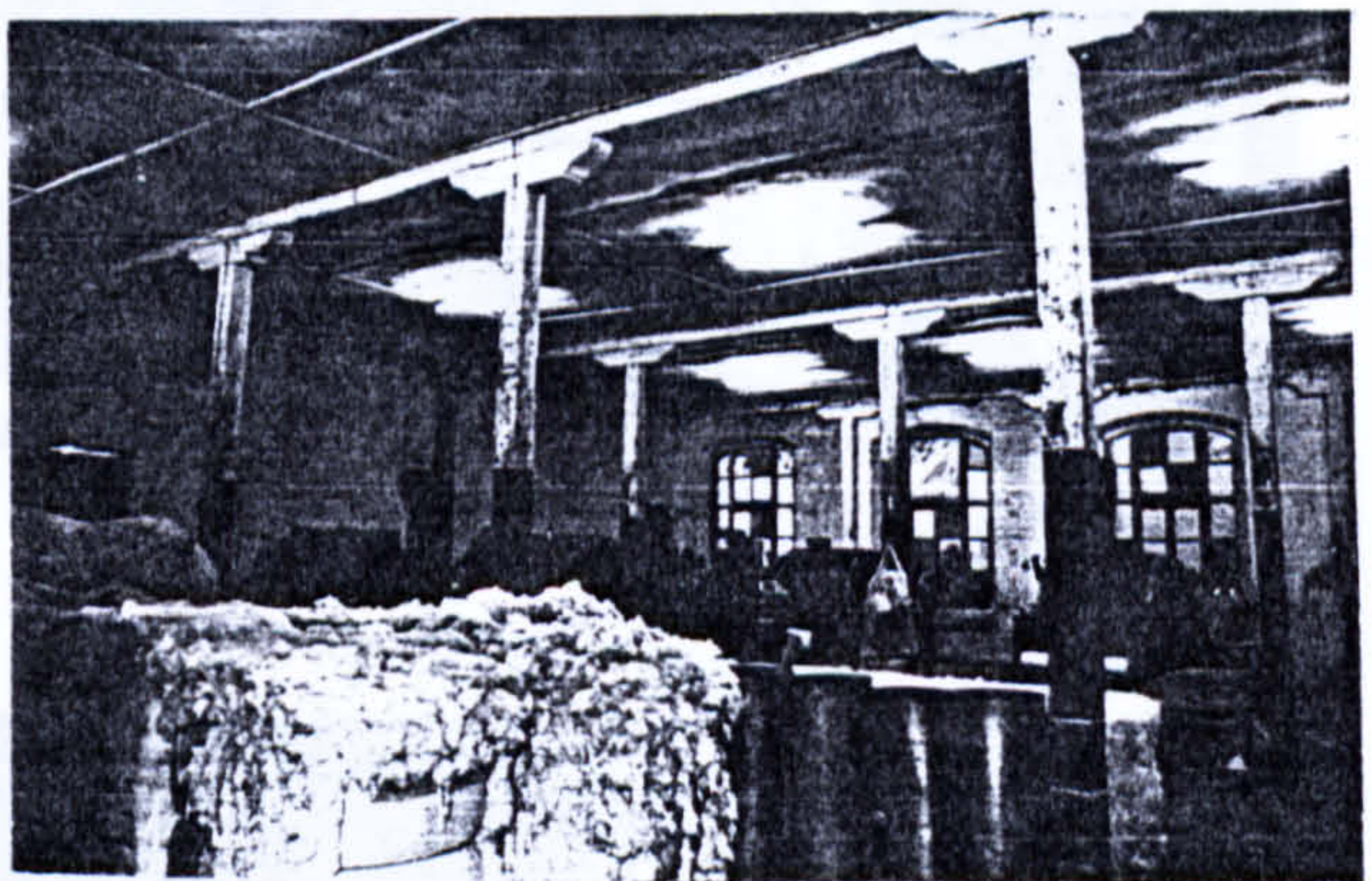
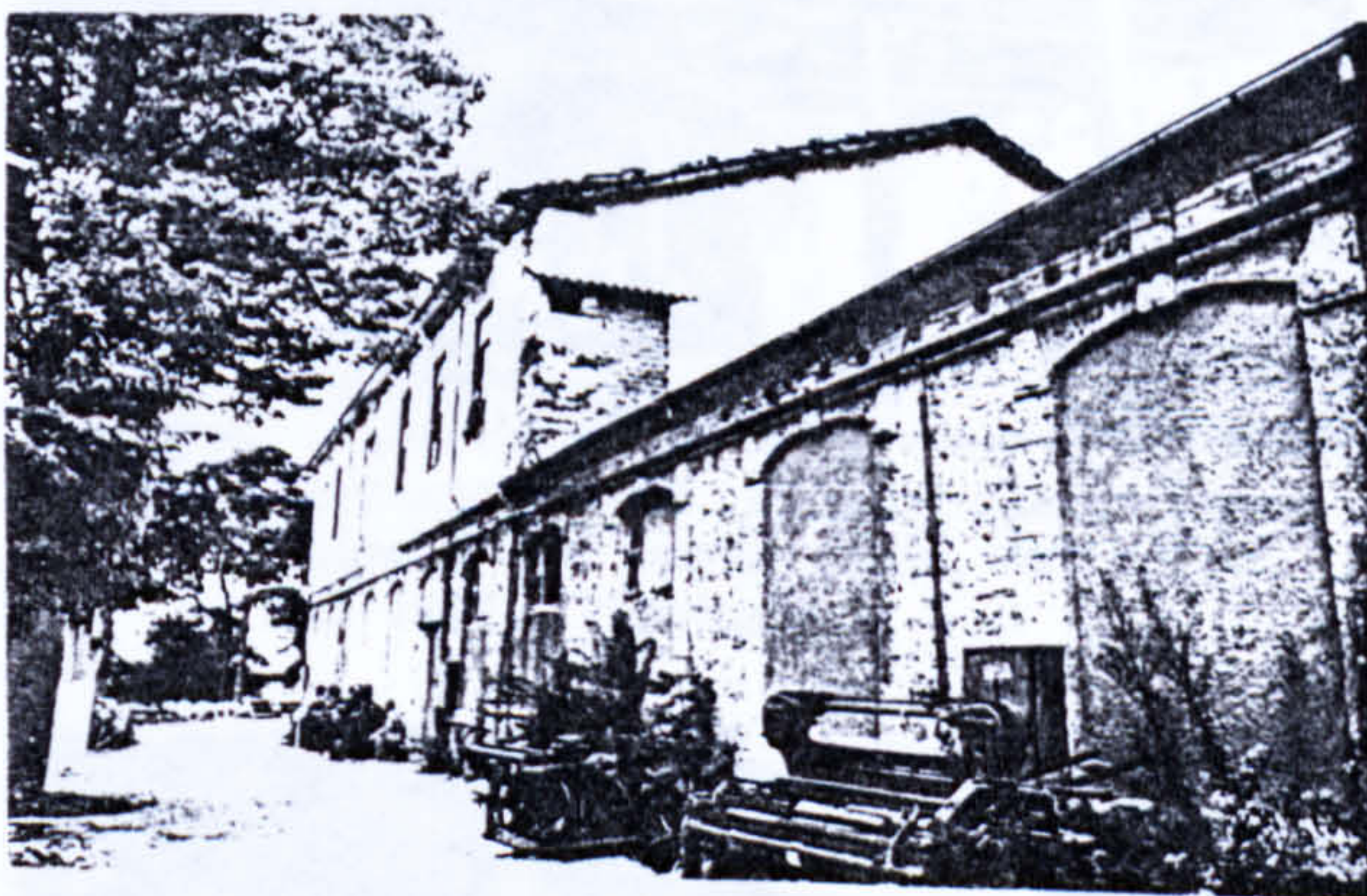
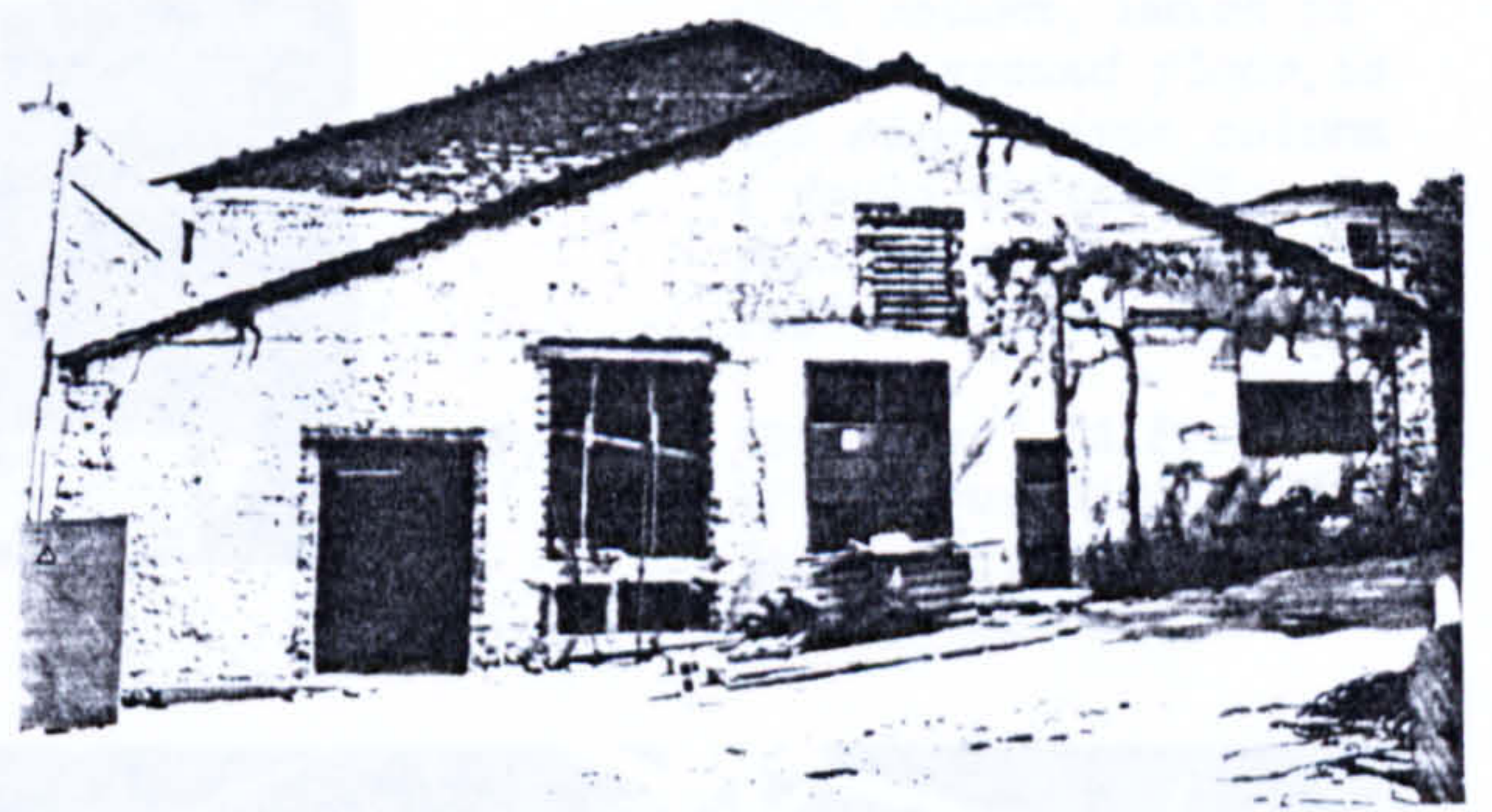


Fig. 156. 'Ifen A. Hadjiantoniou & Co' (A. 6). View of the factory whose windows are blocked in. The offices are on the first floor, c.a. 1900, (Naoussa)



Fig. 157. View of the interior space of the manufacturing area of 'Ifen'. Typical wood construction of the traditional Macedonian houses, c.a. 1900, (Naoussa)

Fig. 158. 'K. and A. Drakopoulos Weaving Mill' (A. 2), c.a. 1882, (Athens)

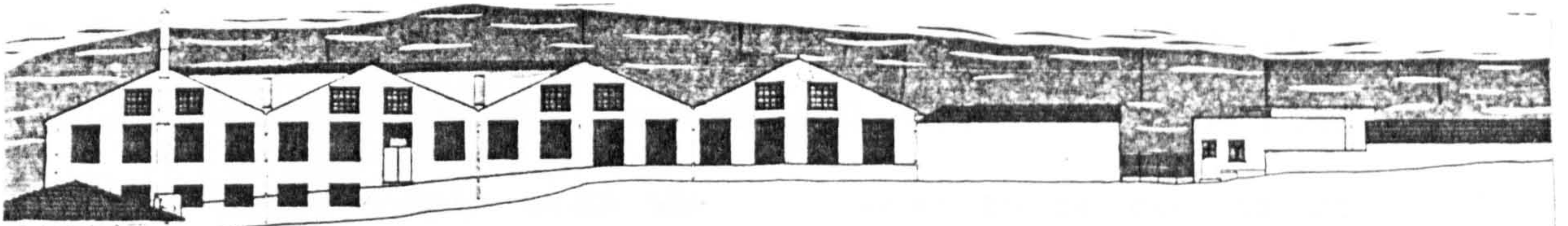


Fig. 159. 'Spinning & Weaving Mills of Edessa' (A.4). View of the spinning department from the road, bet. 1884 and 1912, (Edessa)

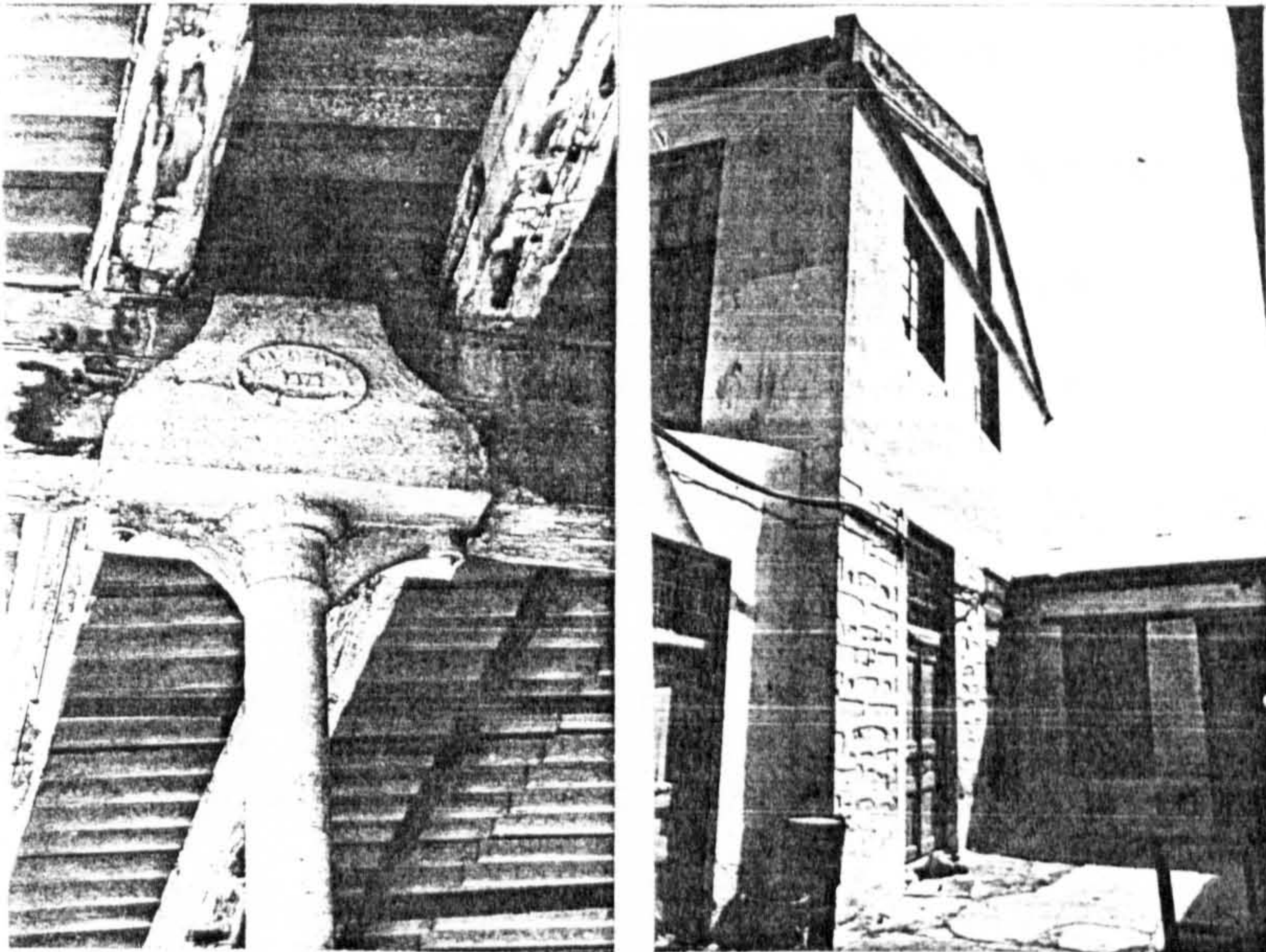


Fig. 160. 'Protopapas G.'. The iron column, which is on the ground floor, is the oldest iron column I found in textile factories in Greece, bet. 1900 and 1906, (Piraeus)

Fig. 161. 'Barbetas' (A.8). View of the building used for dying, beg. of 20's -1936, (Syros)



Fig. 162. 'Protopapas G.'. View of the interior space of the upper floor, bet. 1900 and 1906, (Piraeus)



Fig. 163. A mill next to 'Barbetas'. Wooden roof construction on concrete columns, (Syros)

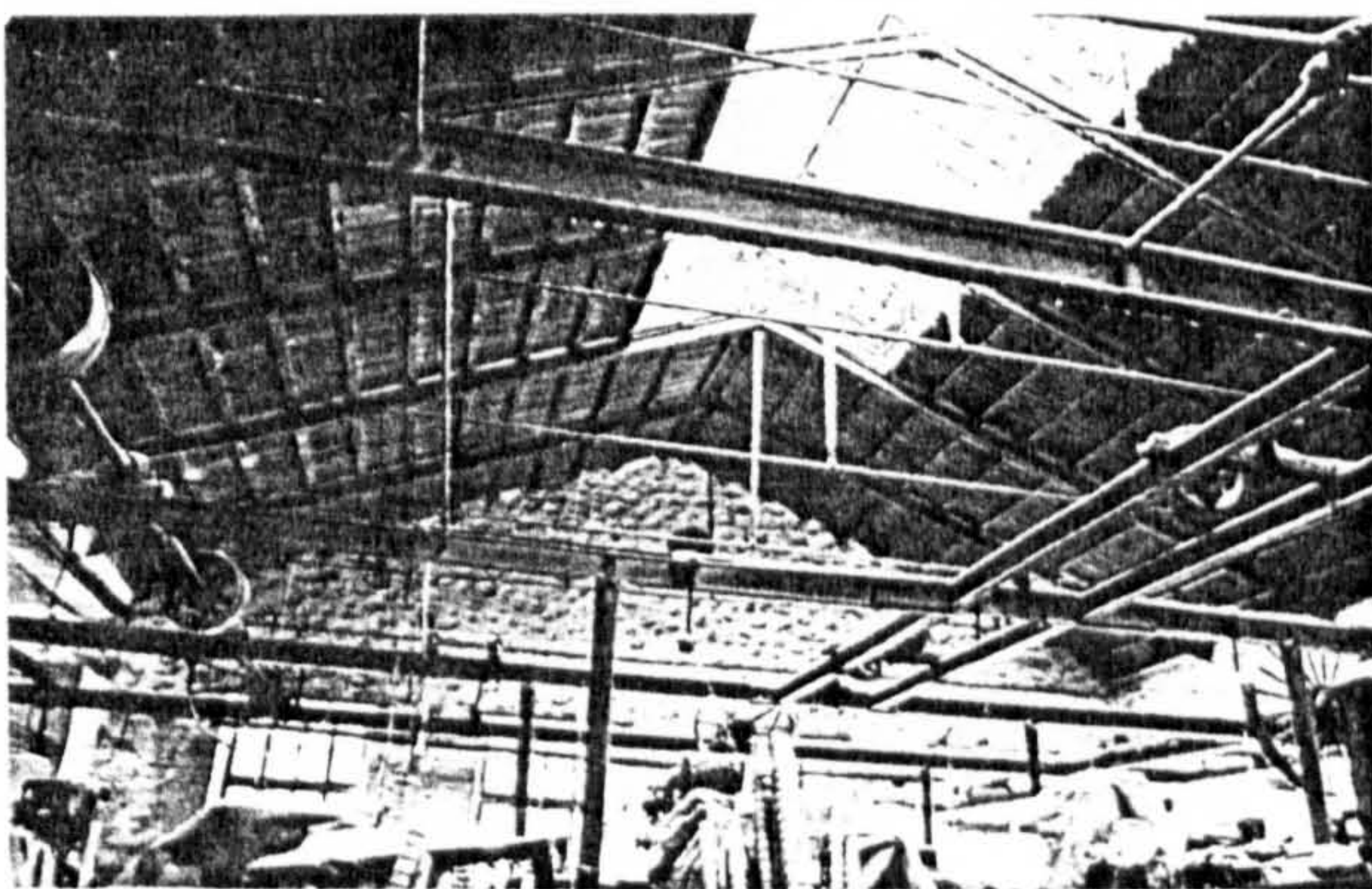


Fig. 164. 'Barbetas' (A.3). View of the steel construction of the roof. The round iron columns are masts of old ships, beg. of 20's-1936, (Syros)

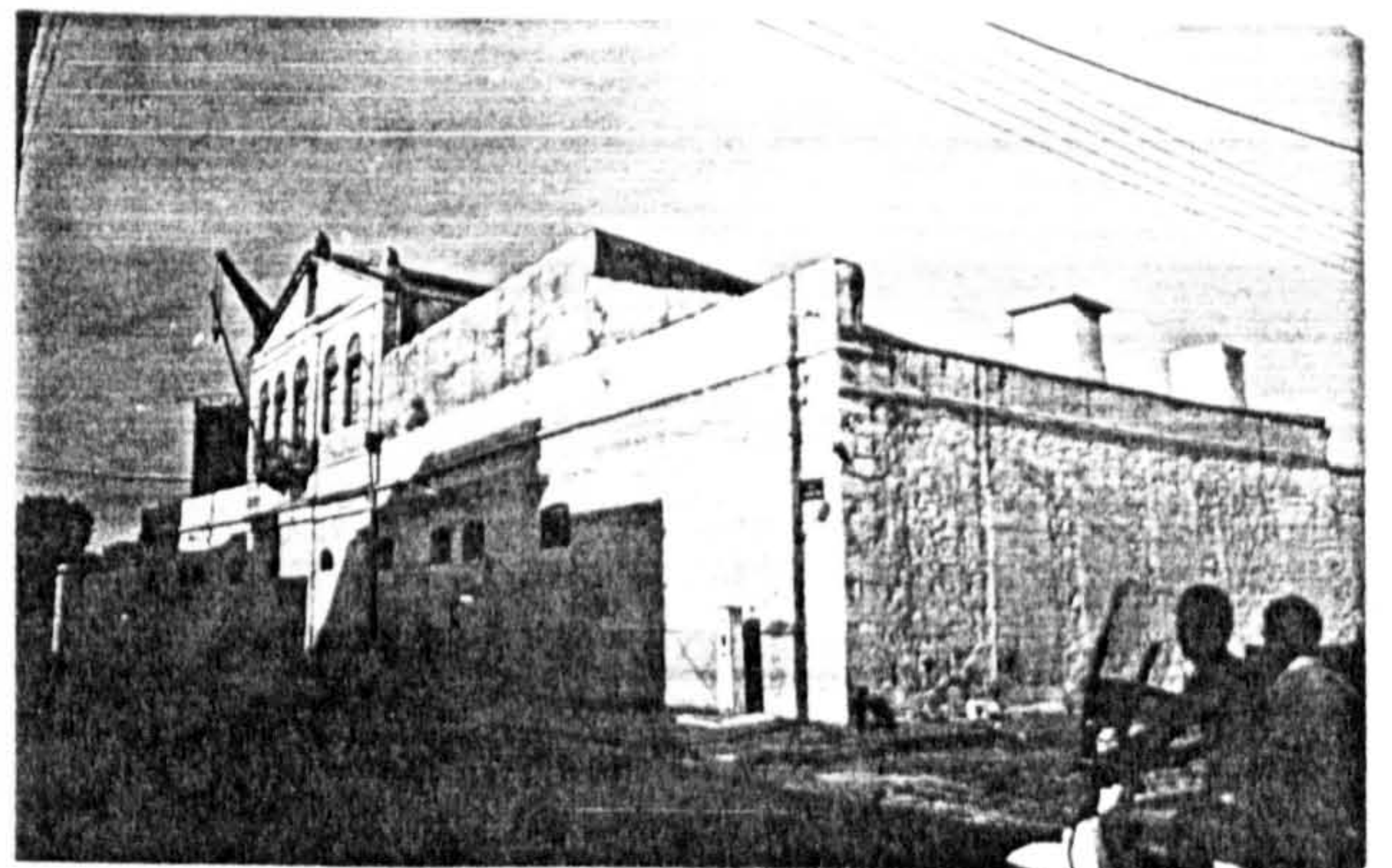


Fig. 165. 'Aegeon Mills' (A.5). View from the main road. The sequence of gabled roofs is hidden behind the parapet, c.a. 1887, (Syros)

After about 1925 concrete replaces wood in industrial building construction. The new material is fireproof and allows larger spans than wood trusses to be constructed. Furthermore, it makes possible the wider use of northern light roofs (fig. 166) which are considered appropriate to obtain the required lighting standards in single-storey buildings. However, seldom in cases (A.1, A.7, A.21, and fig. 77, 169, 173) before 1920 there are wooden saw tooth roof constructions with wooden or round iron columns.

From all the examples of the sample only one (A.10) is a multi-storey building with a northern light roof. Most of the plants combine single-storey buildings with saw tooth roofs, with multi-storey buildings with flat roofs. The partitioned walls are usually made of brick or rarely, of stone covered with white stucco.

After the War, the complete domination of concrete as the material used for skeleton frame constructions takes place. The roofing system remains unchanged until the end of the 50's; most of the single storey shopfloors have a saw tooth roof (fig. 179, 180, 181) and thus lighting from the roof with natural light. Multi-storey buildings have the conventional skeleton system: concrete slabs with dropped beams and flat roof (fig. 177). The presence of the internal columns is still acting as a limiting factor to the arrangement of the machines.

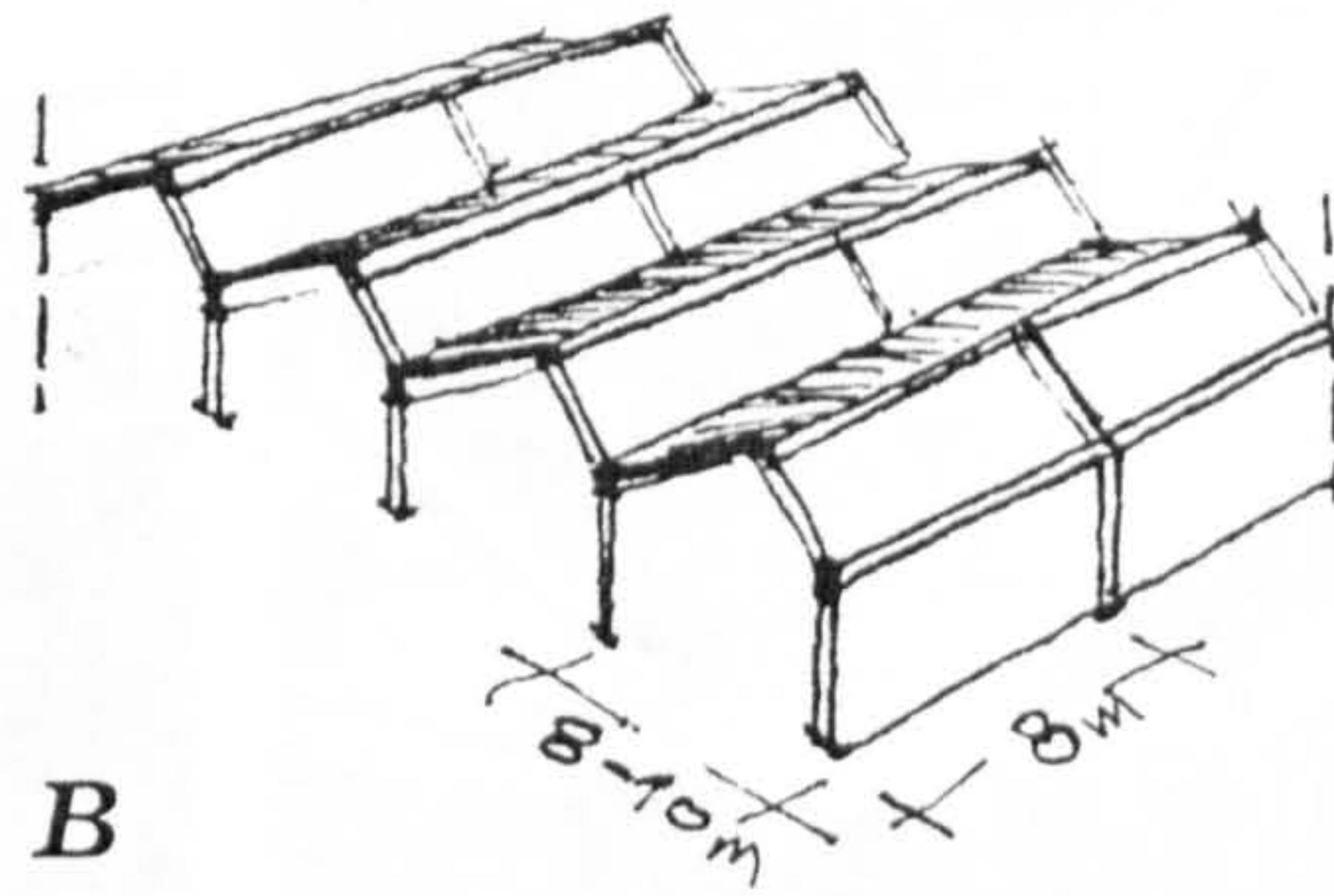
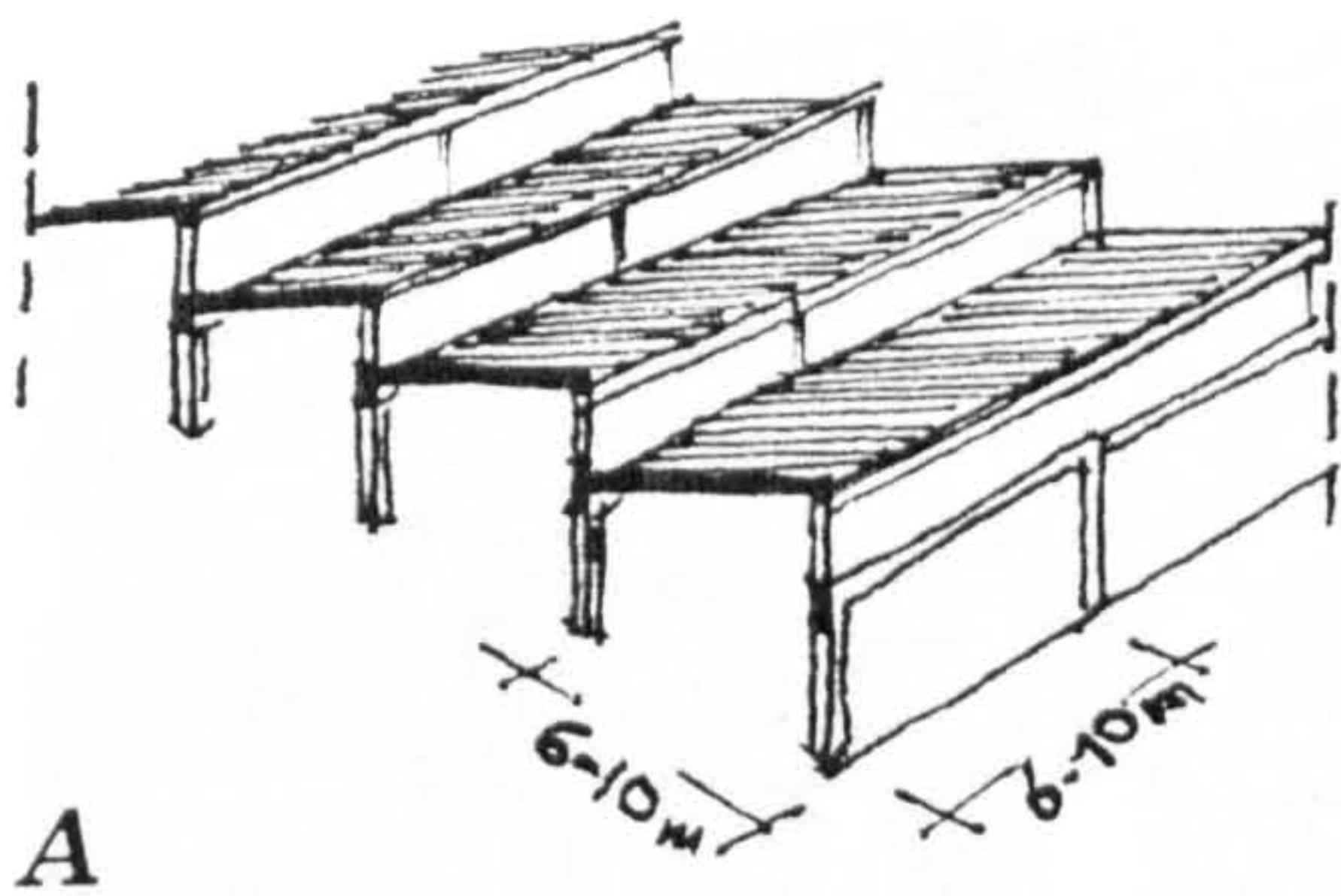


Fig.166. Saw tooth roofing system with vertical teeth (a,c,d) or inclined (b)

Examples of Pre-War Saw Tooth Roofs



Fig.167. 'Sigaras, C. Wool Industries' (A.12). View of the building used for spinning, 1925, (Athens)



Fig.168. 'Pella-Olympos Maced. Spinning & Weaving Mills' (A.10). View from the courtyard. On the left side is the building used for weaving with the saw tooth roof, before 1920, (Naoussa)

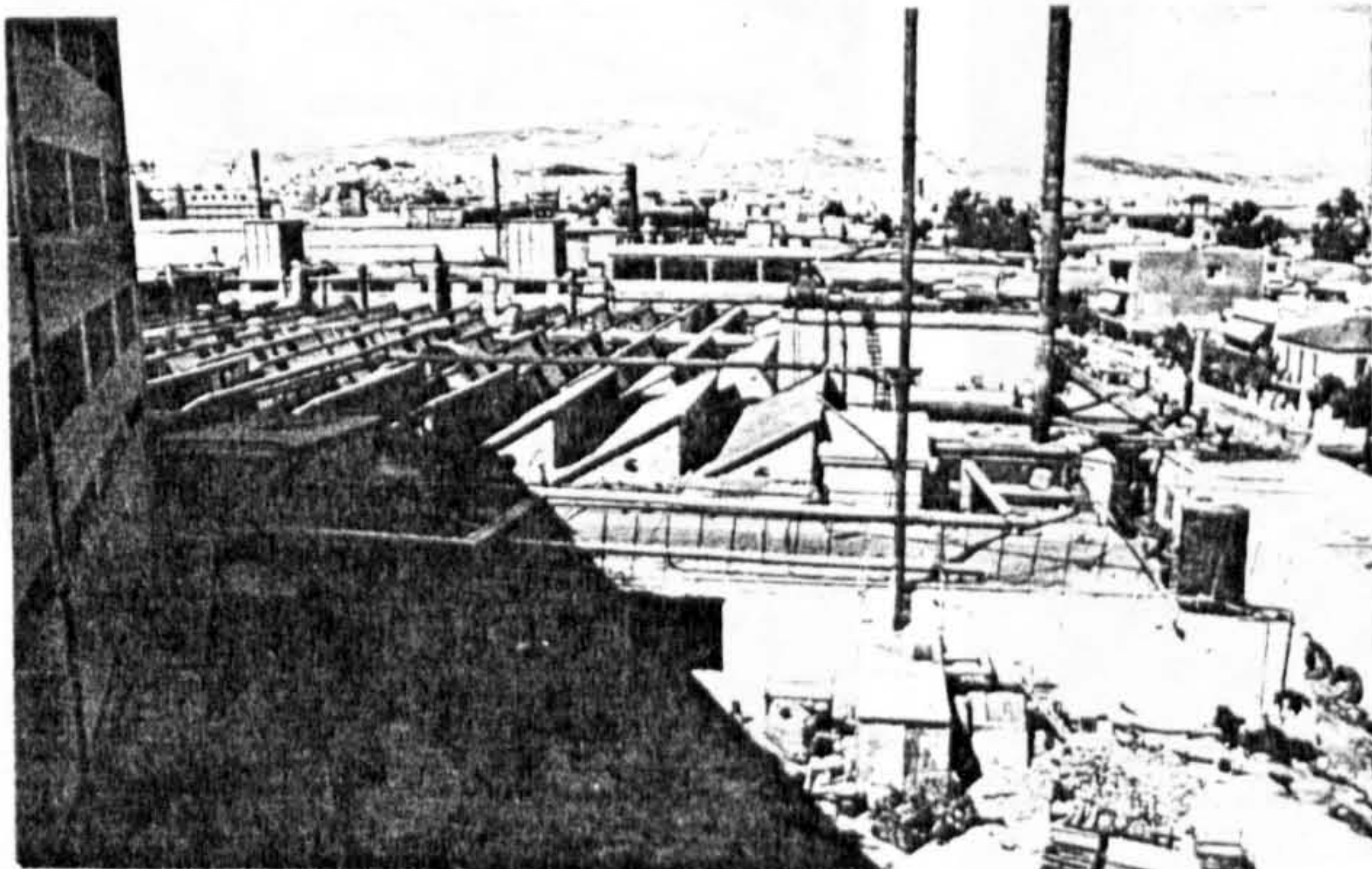


Fig.169. 'Aegeon Mills' Saw tooth roof with iron columns, 1910, (Athens)



Fig.170. 'Syros Spinning Mills' (A.21). Wooden saw tooth construction, 1890's, (Syros)

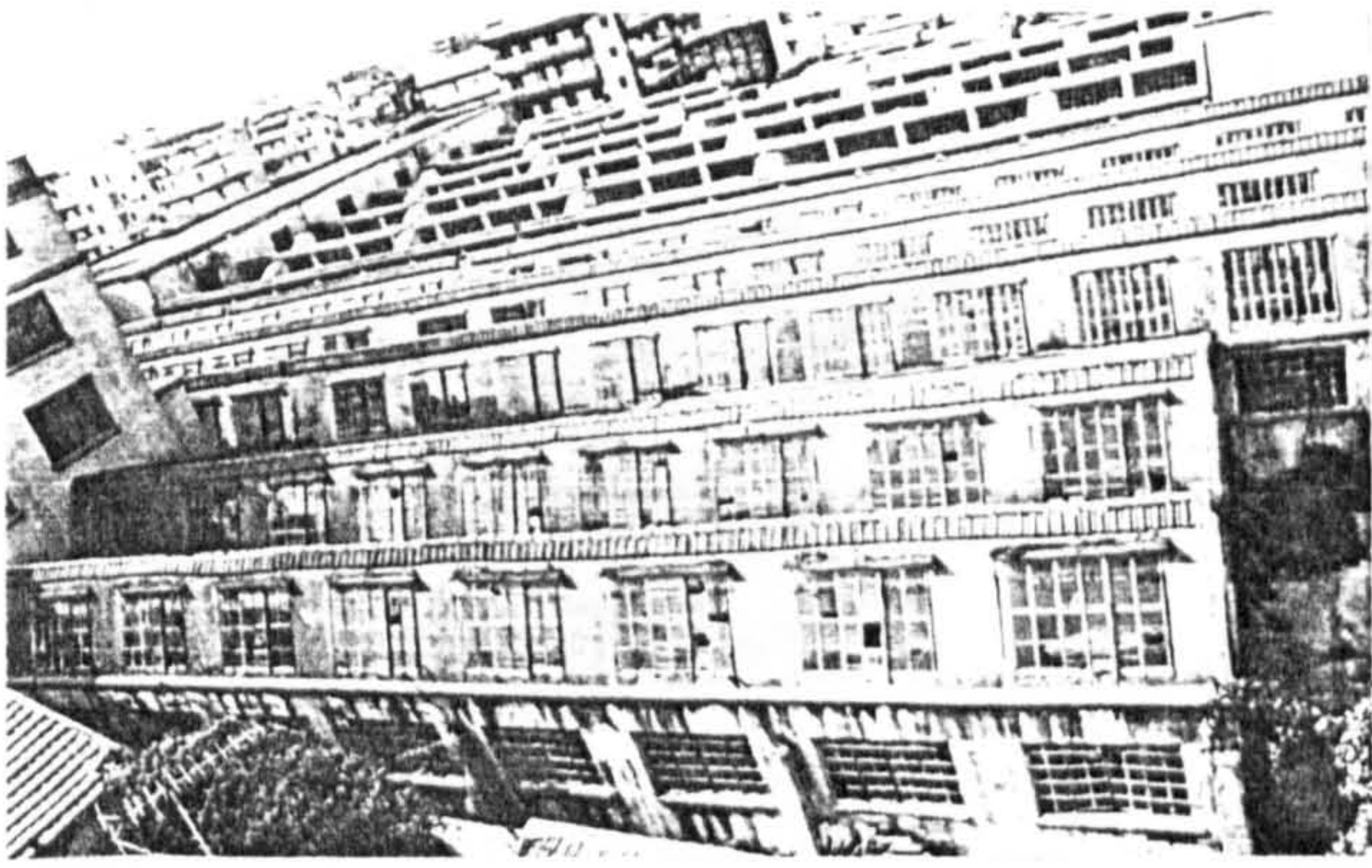


Fig.171. 'Ifanet' (A.7). Impressive sequence of northern light roofs. The concrete frame has been constructed at the end of 30's, (Thessaloniki)

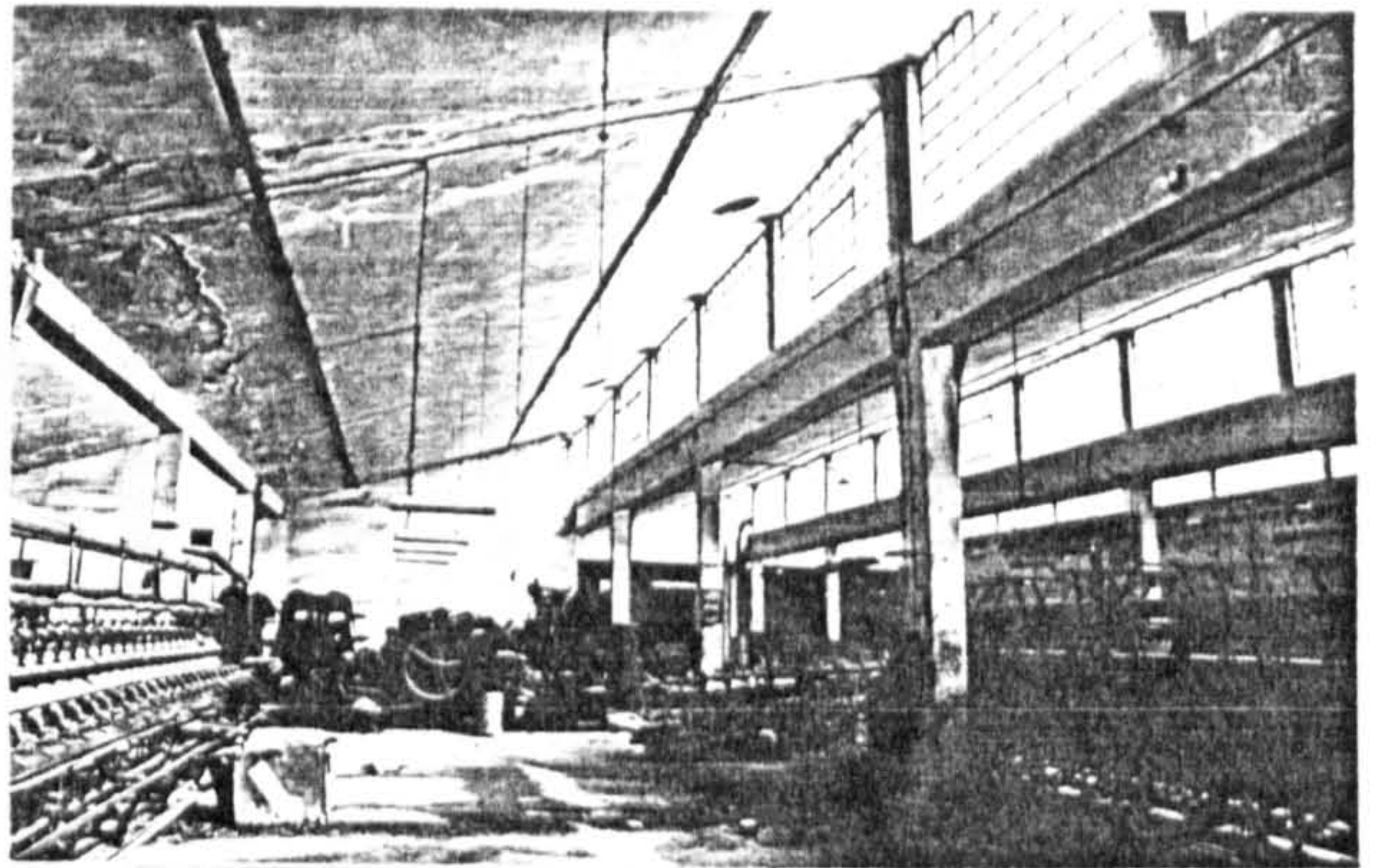


Fig.172. 'Ifanet'. View of the interior, (Thessaloniki)



Fig.173. 'Lanaras-Kirtsis Mills'. Double storey shopfloor with saw tooth roof, 1930's, (Athens)

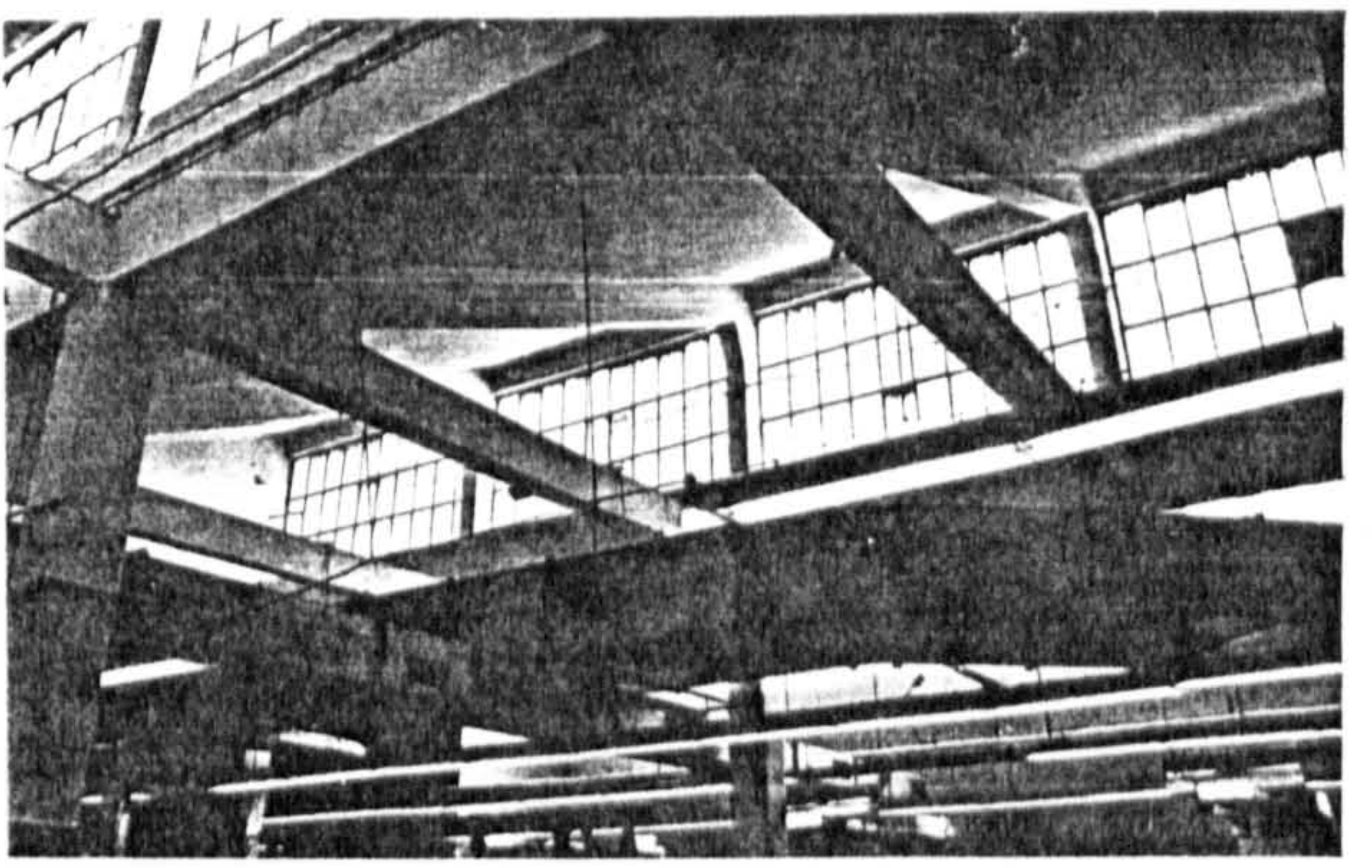


Fig.175. 'Kriticos, H.' (A.19). View of the roof from the interior space, 1930's, (Patra)

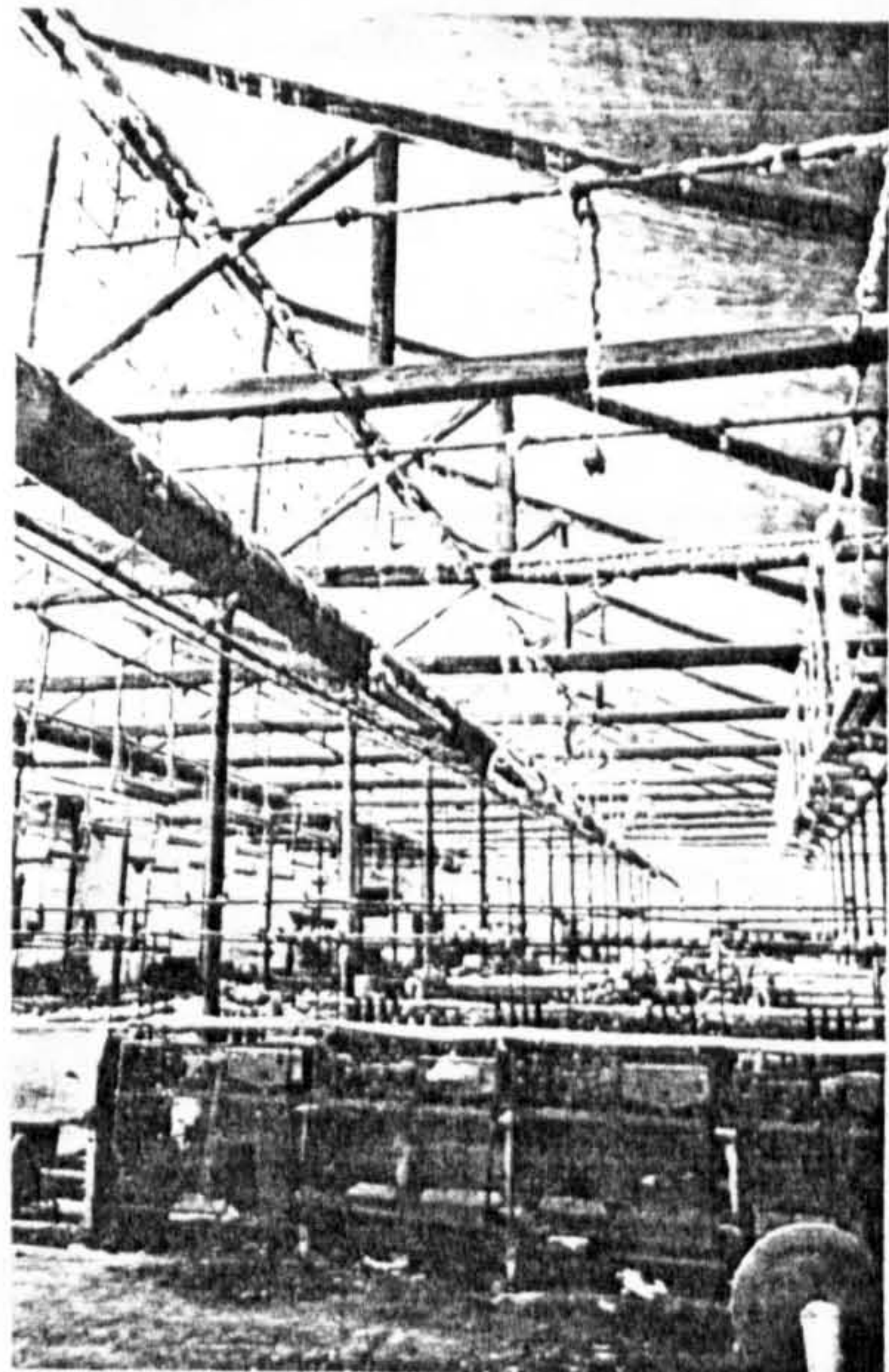


Fig.174. 'Retsina Bros, Spinning & Weaving Co' (A.1). Wooden saw tooth roof with round iron columns, 1873, (Piraeus)

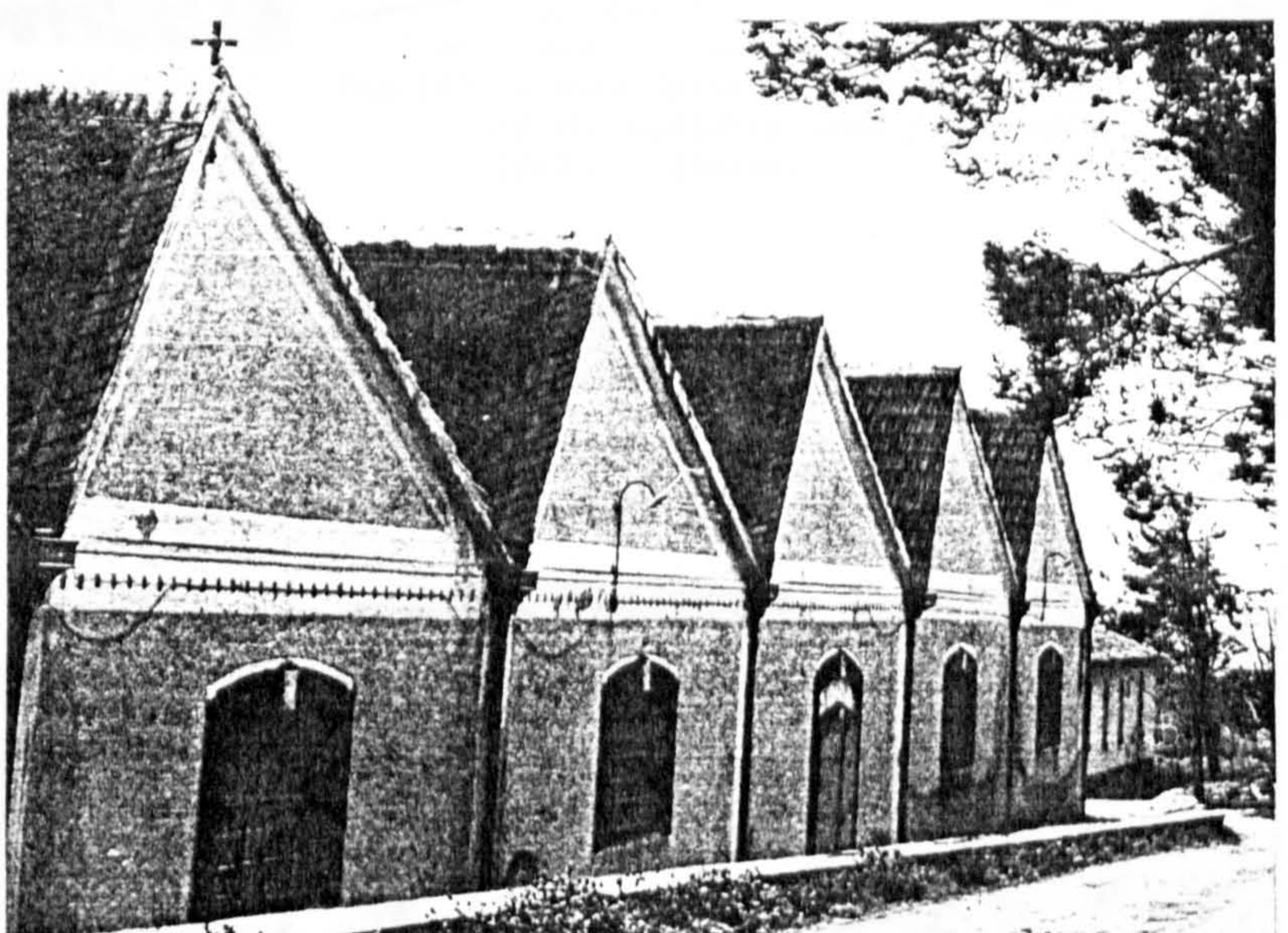


Fig.176. 'Sefeco Wool Industry' (A.11), 1930's, (Edessa)

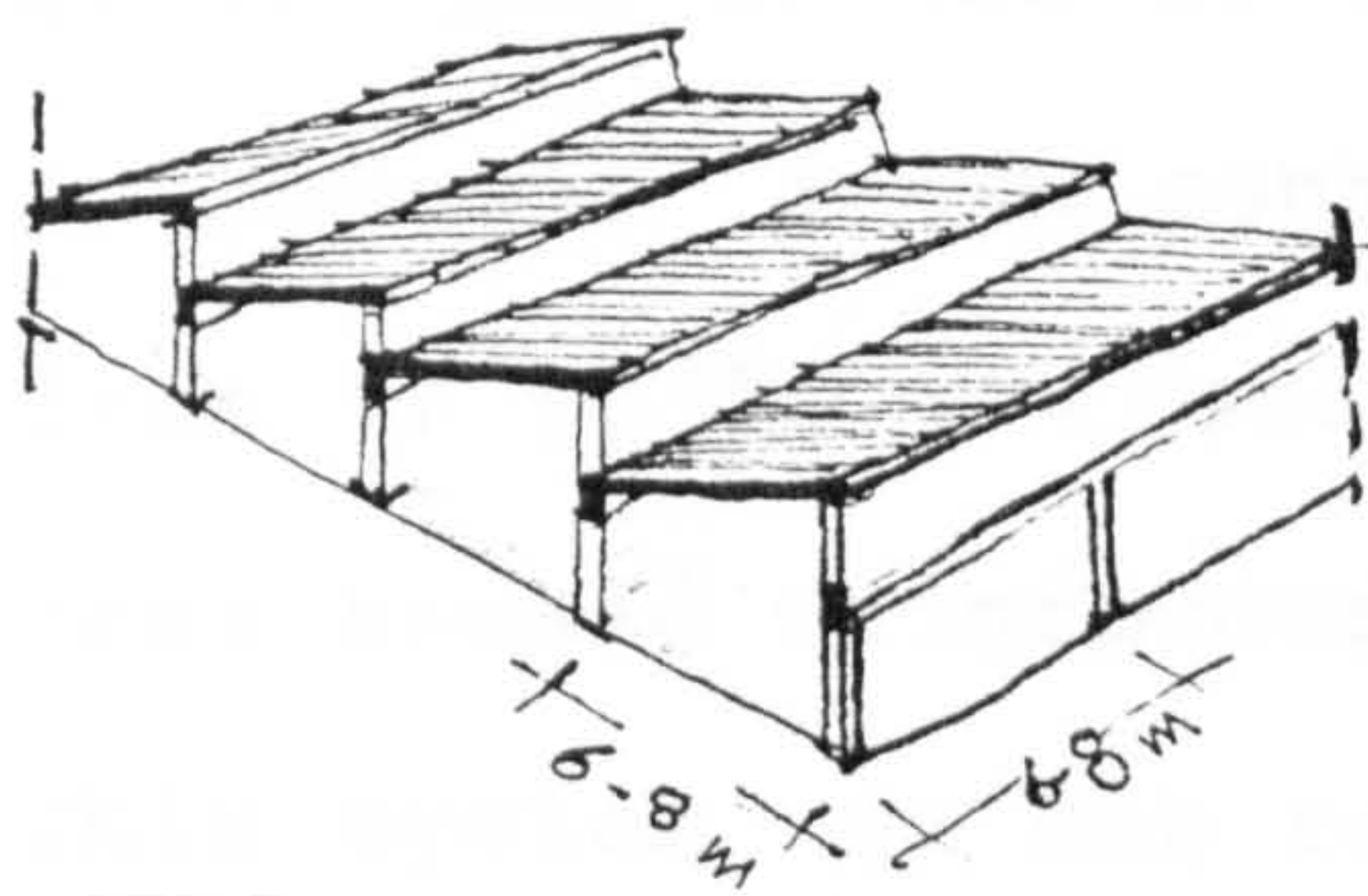


Fig. 177

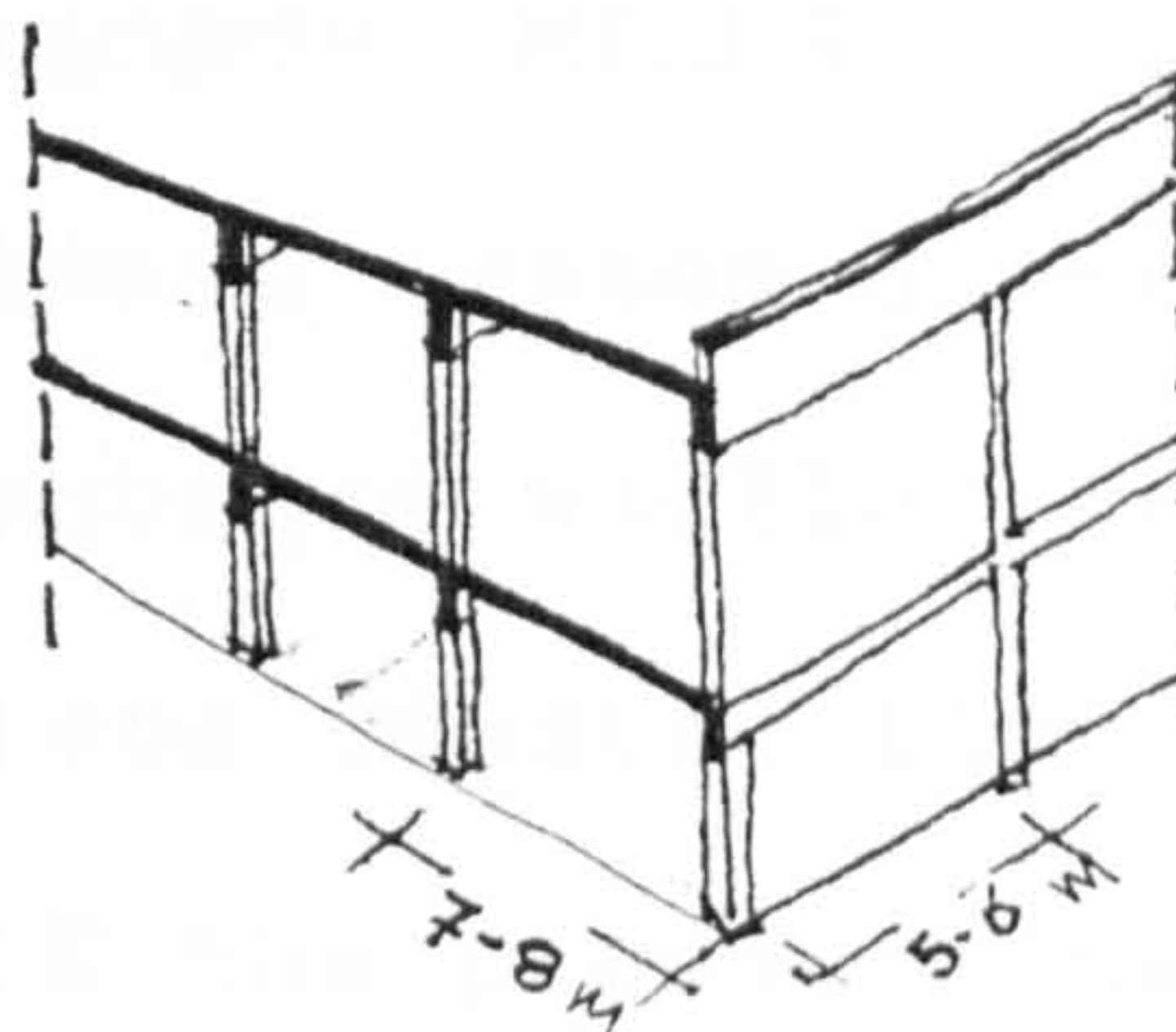


Fig. 178

Examples of Saw Tooth Roofs after the War



Fig. 179. 'Piraiki Patraiki Cotton Manufacturing' (A.27). Aerial view, beg. of 50's, (Syros) 28



Fig. 180. 'Athina Spinning Weaving' (A.24). View of the building used for weaving, 1940's, (Athens)



Fig. 181. 'Piraiki Patraiki Cotton Manufacturing' (A.22). View of the main entrance and the shopfloor. The saw tooth roof is outlined in the background of the photograph, c.a. 1947, (M. Pejko)

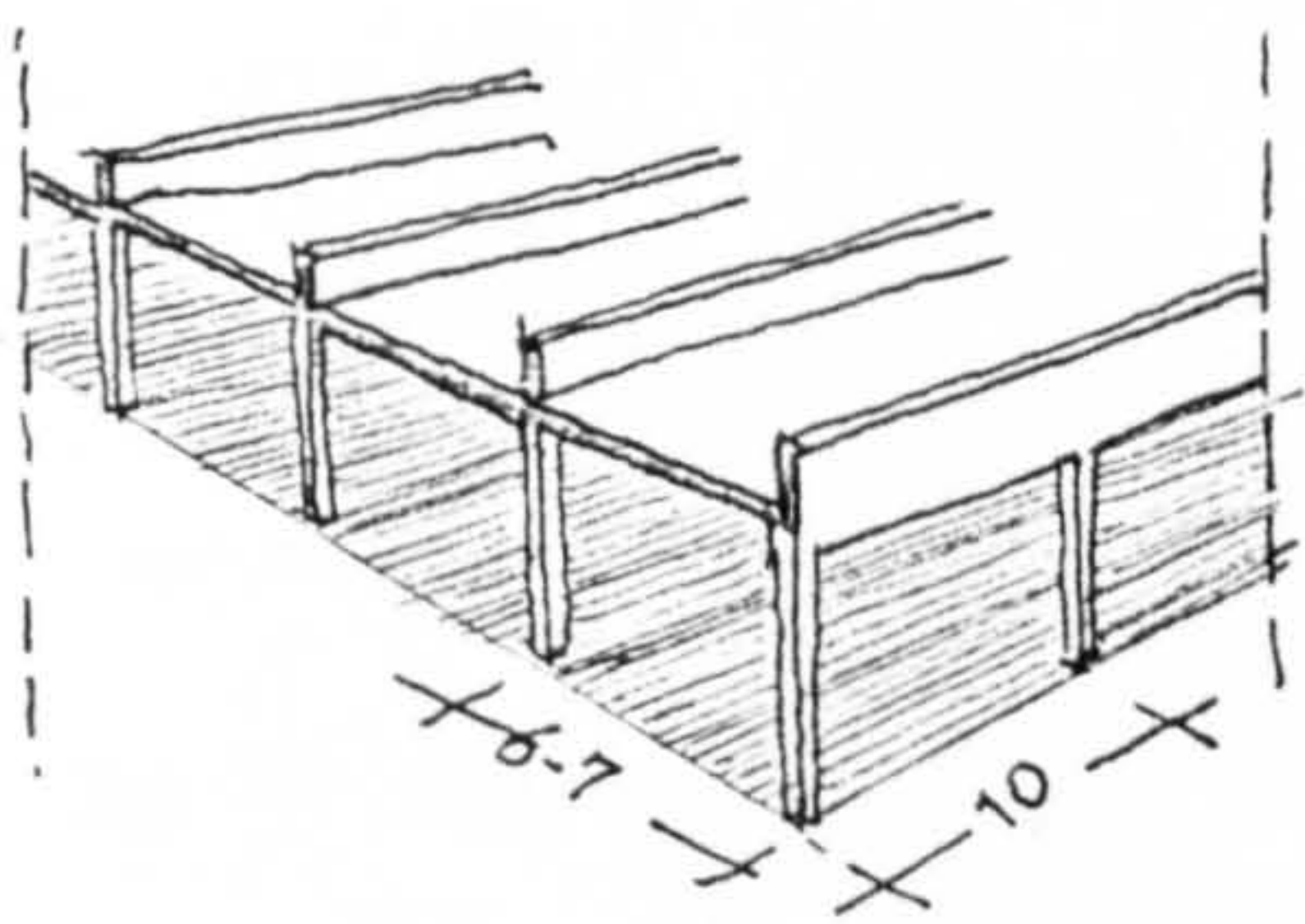


Fig. 182. 'Sacalides, J.' (A.28). The saw tooth roof in the background is not very often found in double storey buildings, beg. of 50's, (Athens)

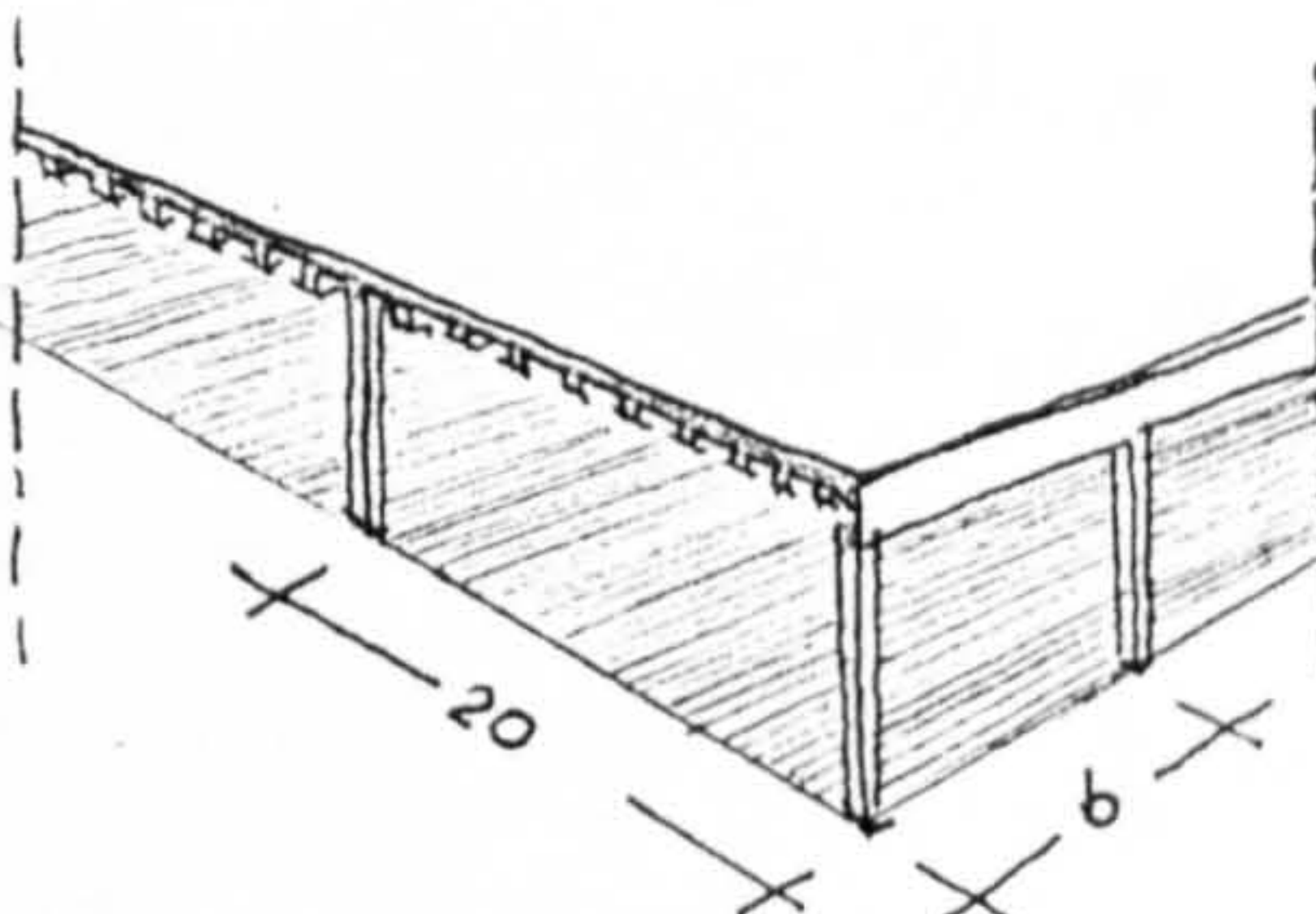
At the end of the 50's the AEGEON MILLS (A.28) at Lavrio, introduces a new constructional system covering spans from 12 to 14 metres: the concrete waffle slab and later prestressed reinforced concrete construction (fig. 183B). This system is the result of the pressing need to achieve a flexible shopfloor for the arrangement of the long machines, and also a building isolated from the external environment, without openings, necessary for the desired controlled internal environment. Probably it is the first building in Greece in which micro-climatic conditions are taken into consideration when it is designed. The external walls of the buildings, as well as the partitions, are made of brick and are plastered with white or grey stucco.

The rapid industrial growth after 1960 is accompanied by the development of a variety of framing systems. Multi-storey buildings use the conventional reinforced concrete frame with horizontal slabs and dropped beams, either prestressed or not. Single-storey buildings use systems from a great variety of options that are illustrated in fig.183 as well as prefabricated concrete slabs, beams and columns (A.43, A.50, A.51).

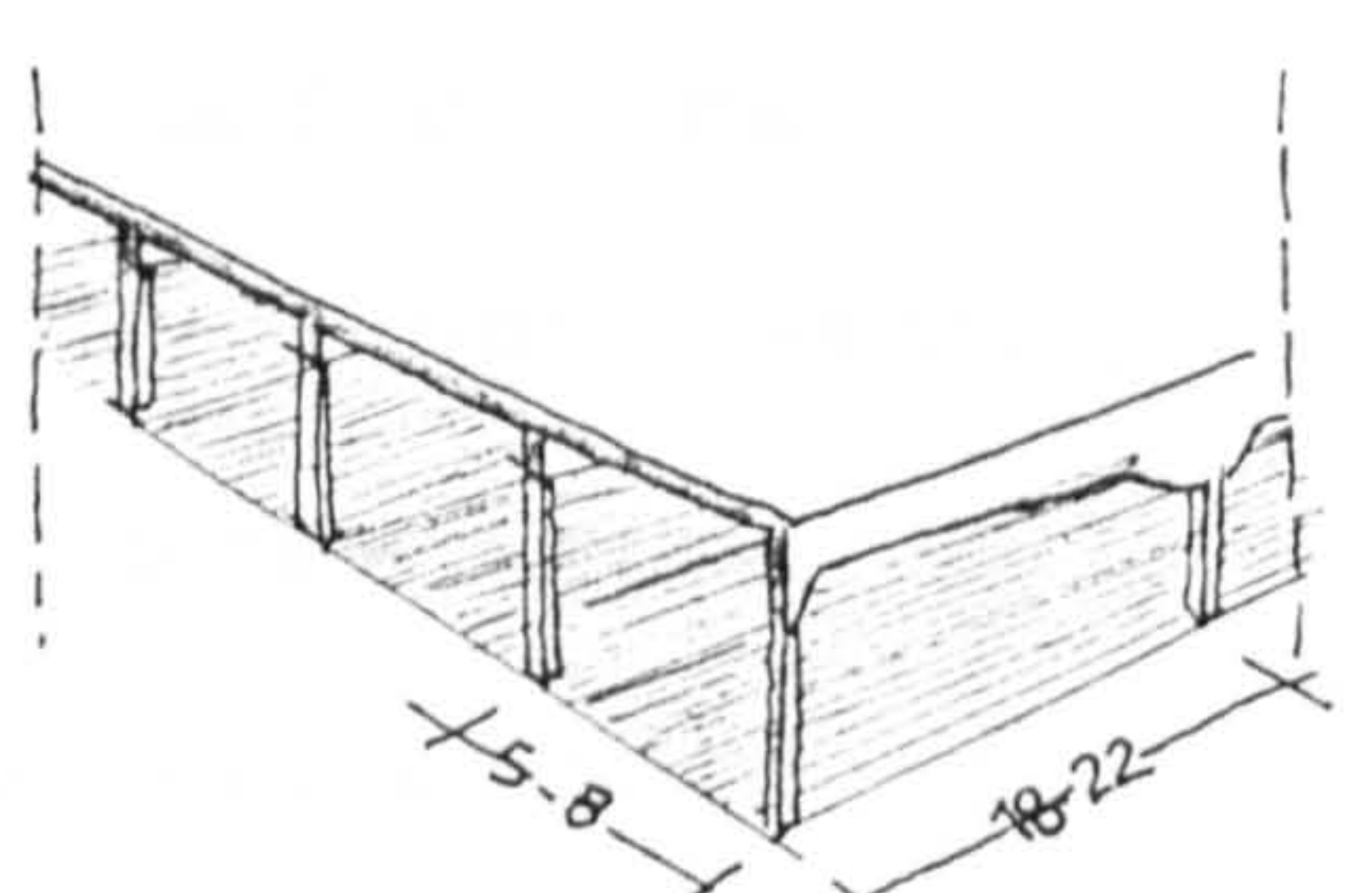
The gradual shift from conventional constructional systems to concrete slabs with inverted beams and finally to steel or prefabricated framing systems is the result of two factors. The first is the need to cover large spans and produce flexible, column free manufacturing areas, and the second is the introduction of an air-conditioning. Air-conditioning systems are based on the distribution of the



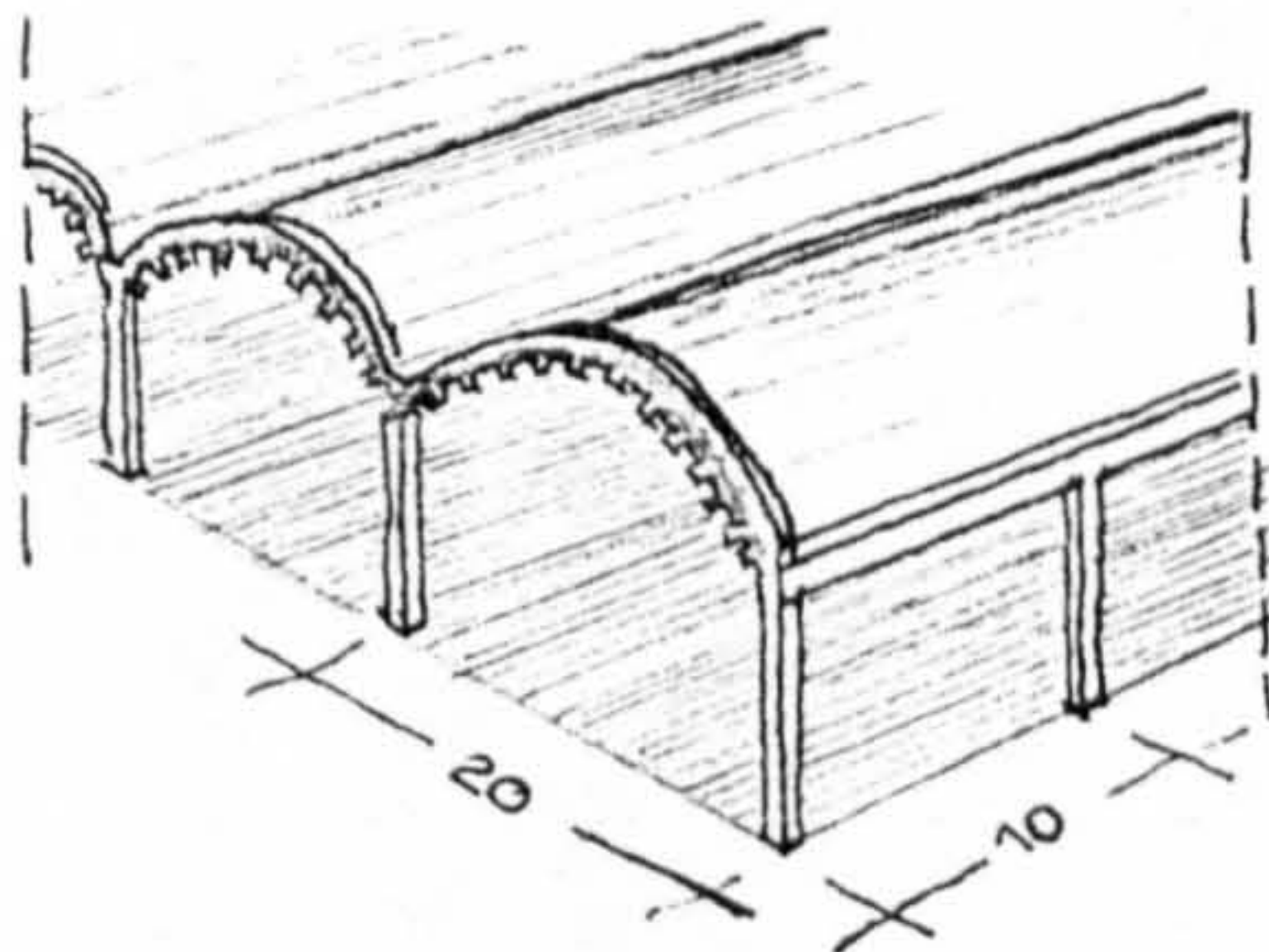
A (2)*
Flat slabs with inverted
beams



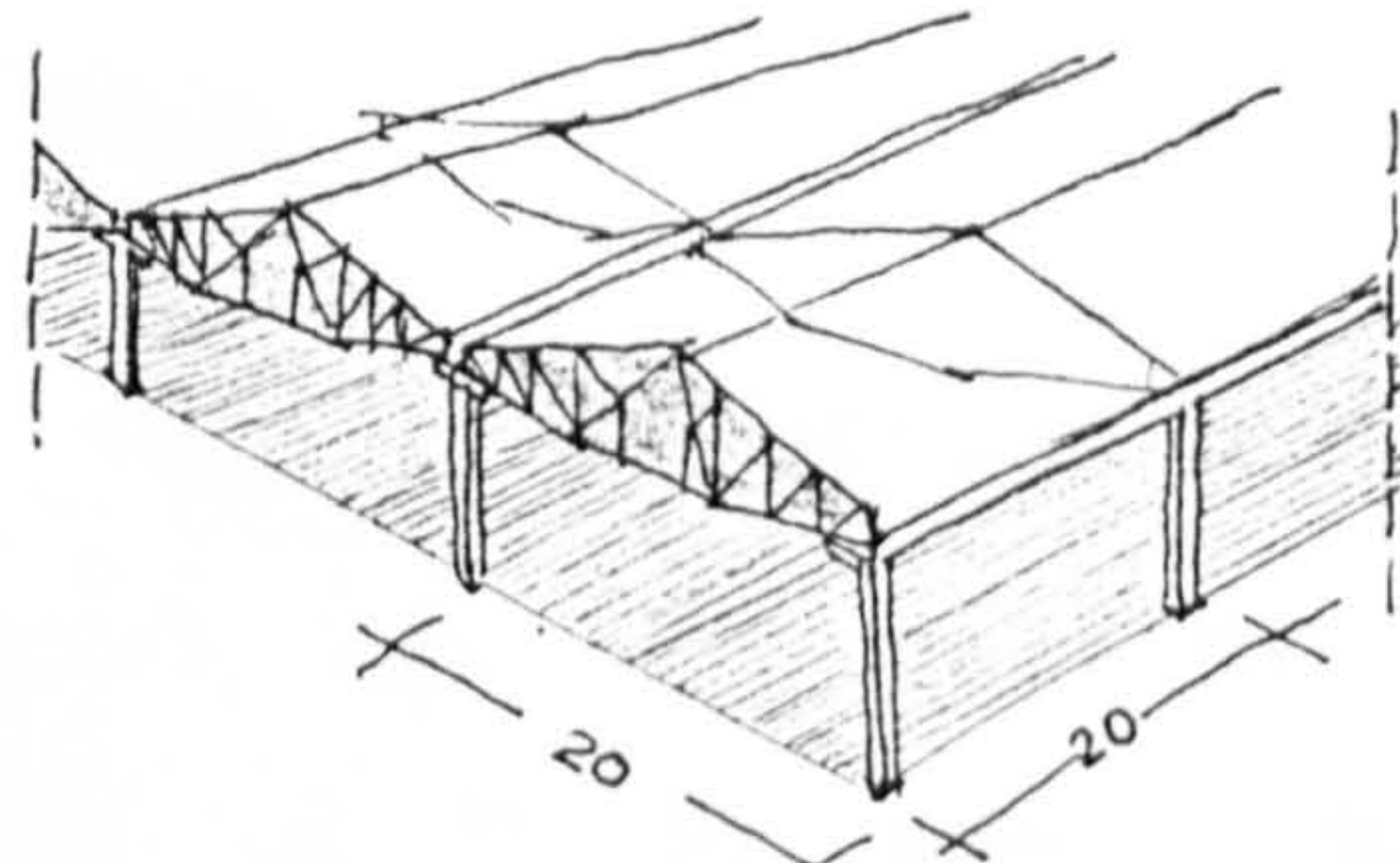
B (1)
Waffle slabs



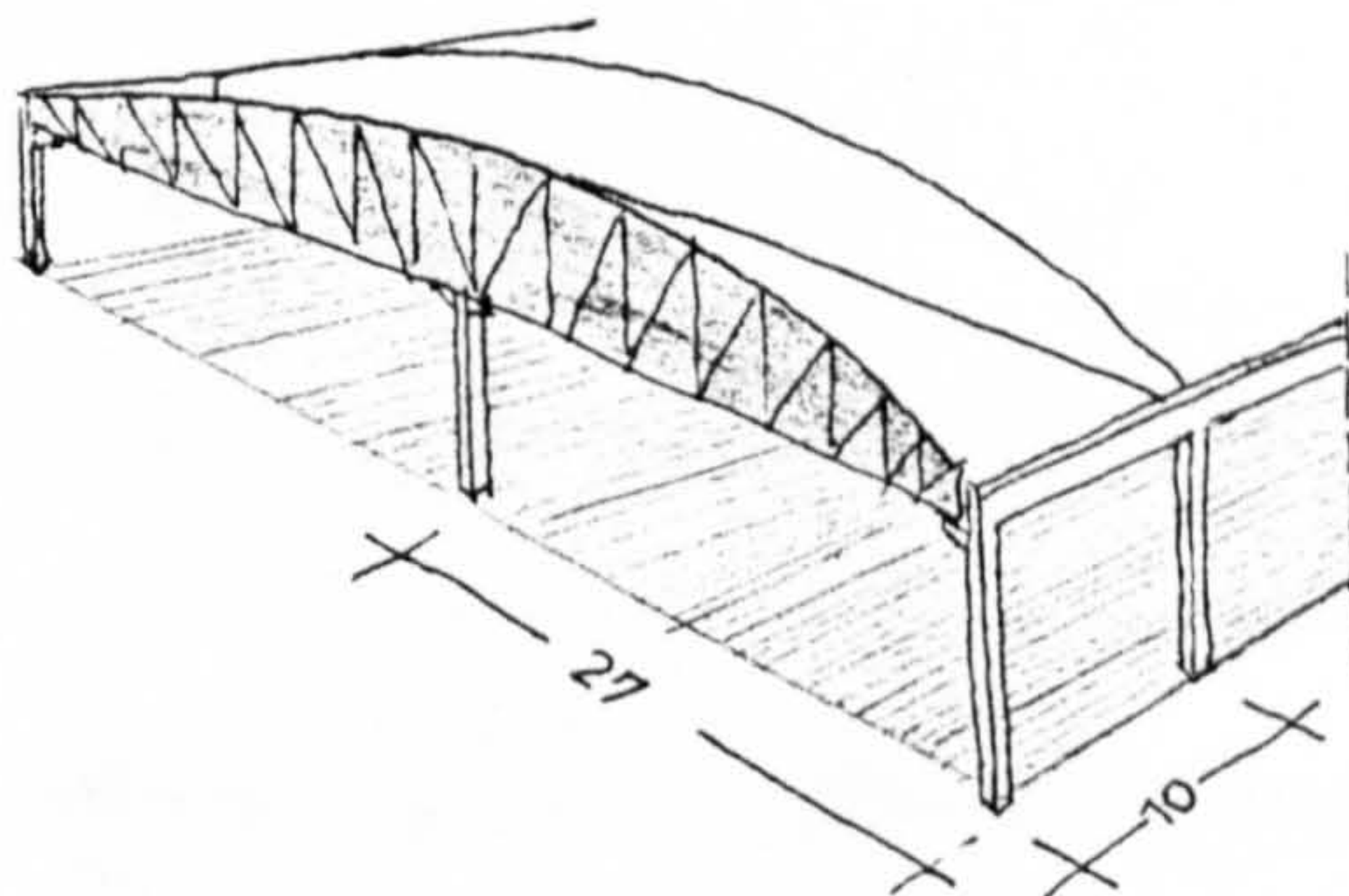
C (3)
Concrete frames



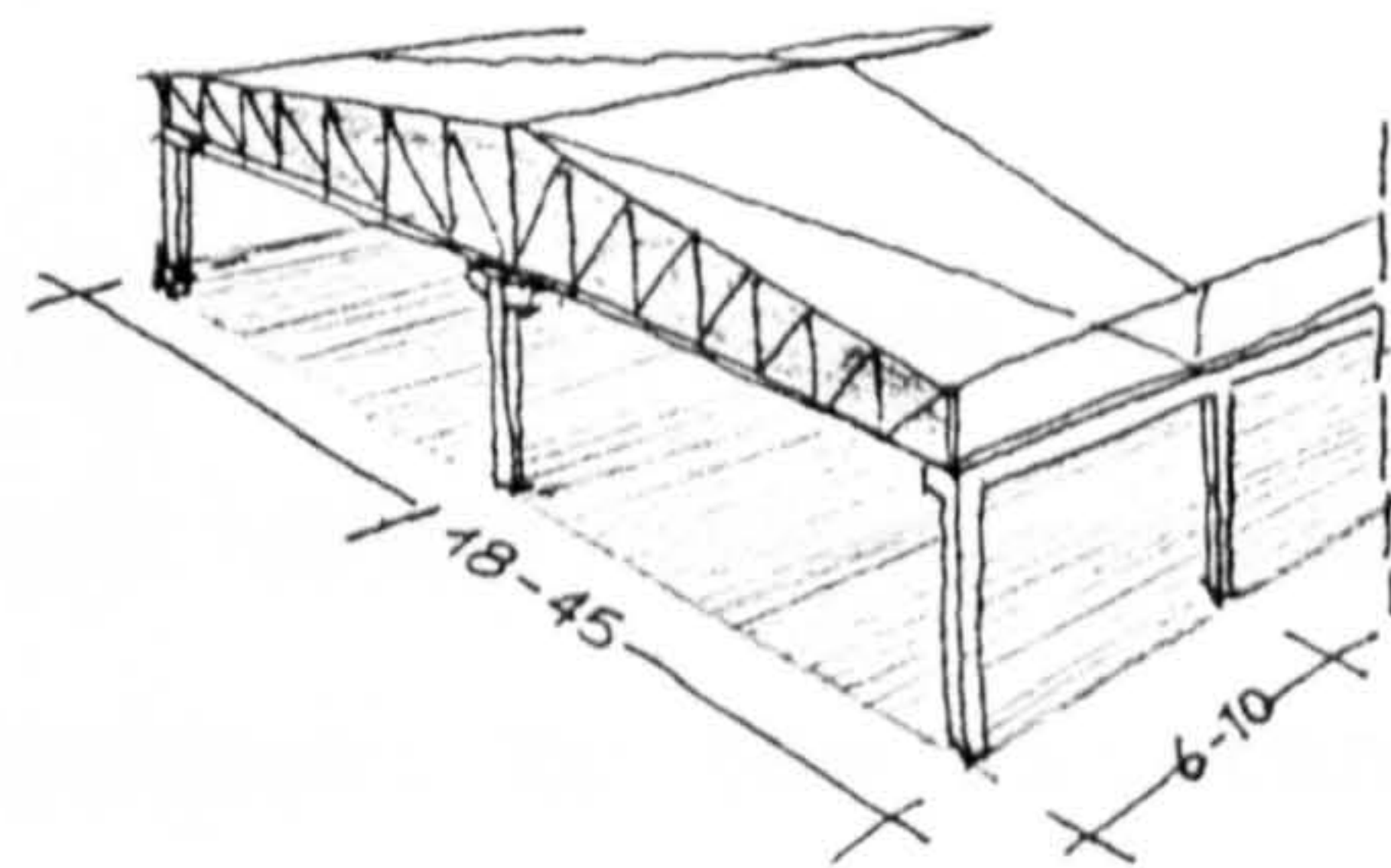
D (1)
Curved ribbed shells



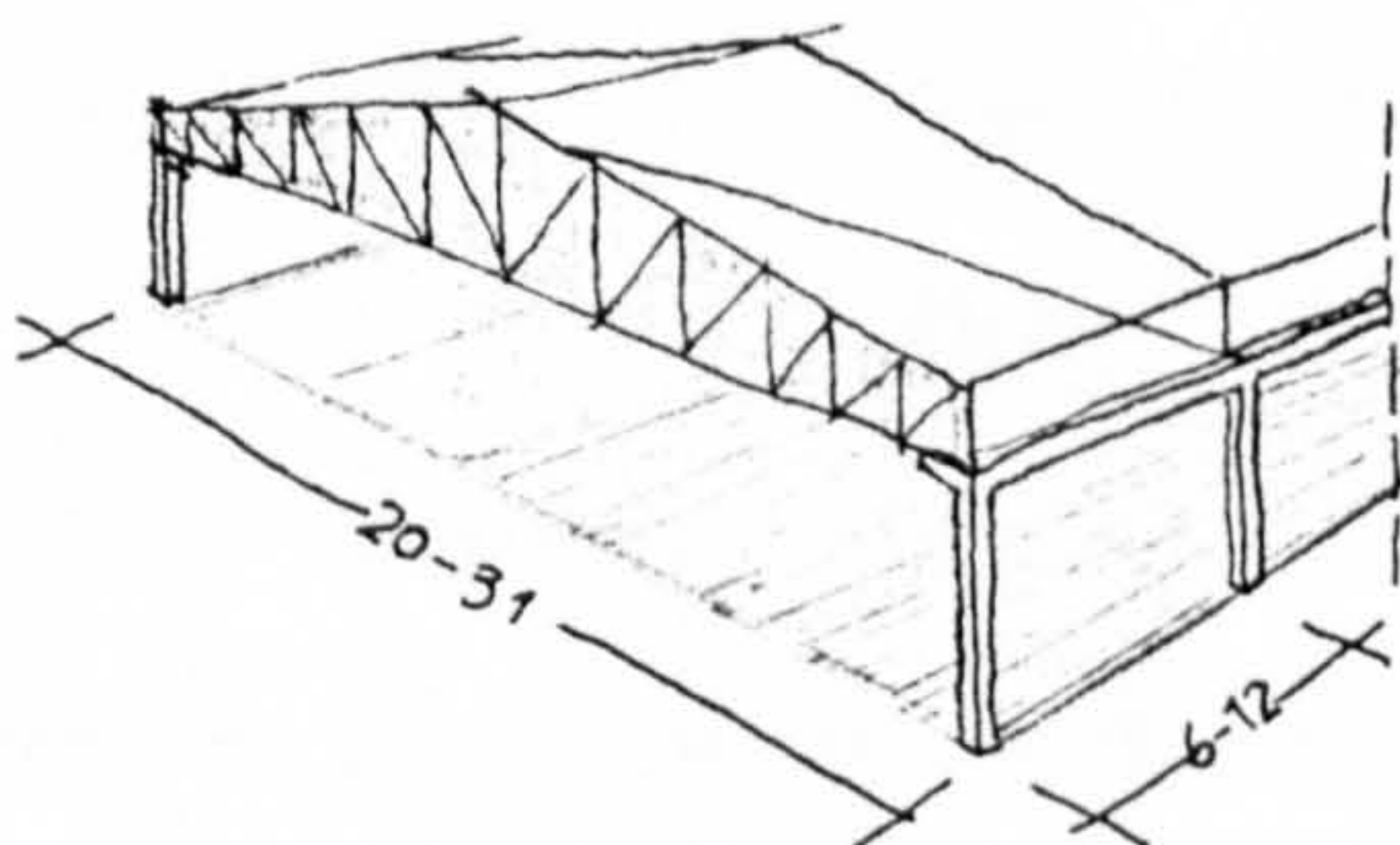
E (1)
Steel trusses with concrete
columns



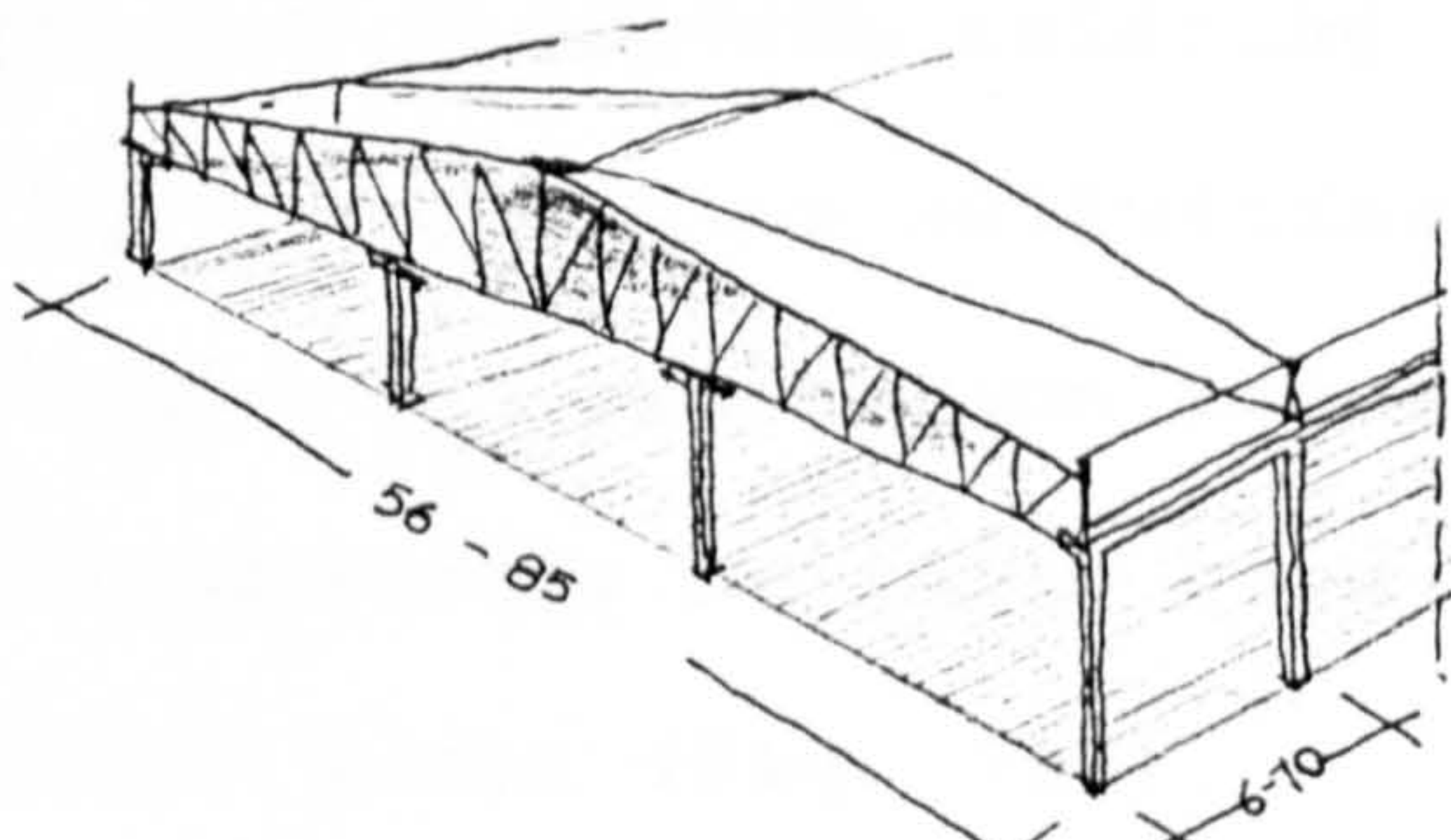
F (1)
Steel trusses with concrete
columns



G (2)
Steel trusses with concrete
columns



H (6)
Steel trusses with concrete
columns



I (2)
Steel trusses with concrete
columns

Fig. 183

*The numbers in brackets indicate the number of buildings of the sample which have the respective constructional system

horizontal ducts at the ceiling under the roof of the building, and the return air ducts under the floor leading to the terminal air units. Fig. 184 shows three types of framing systems in relation to the air-conditioning duct distribution. Conventional construction (fig.184A) has the disadvantage that the horizontal ducts are outside the building on the roof due to the dropped beams which reduce the inner free height of the building.

Partitioned walls are constructed only in the office area and the ancillary facilities' zones, and are made of brick or prefabricated panels. External walls are of brick plastered with stucco and painted white or grey. Occasionally corrugated panels or prefabricated concrete slabs are also used.

Articulation of spaces

The early mills in the area of Naoussa and Edessa combine weaving and spinning activities. The distinction between the two is expressed in spatial requirements by the existence of two separate buildings, either on the same site (A.6, A.10) or in different sites (A.4). The only exception is the firm SEFECO (A.11) which probably for reasons relating to its small size shelters weaving and spinning activities within the same factory enclosure. The production process follows a linear route in a single-storey building or a continuous line in a multi-storey plant (fig. 185).

The shape of plans is rectangular and the width varies between 17 and 35 m. The width of the mill is determined

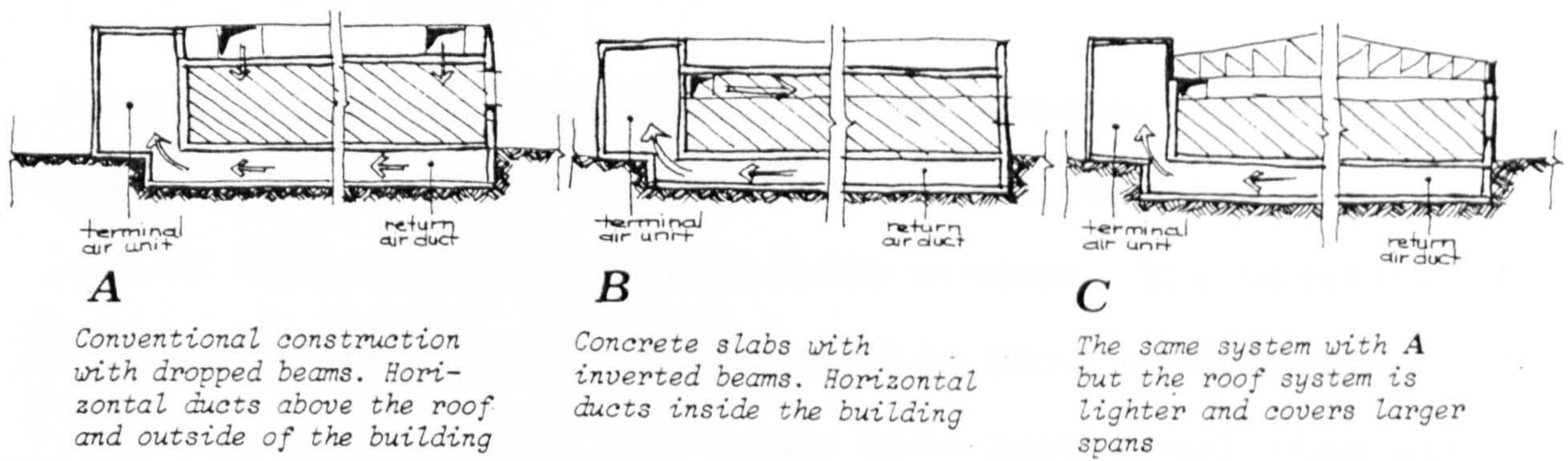


Fig. 184.

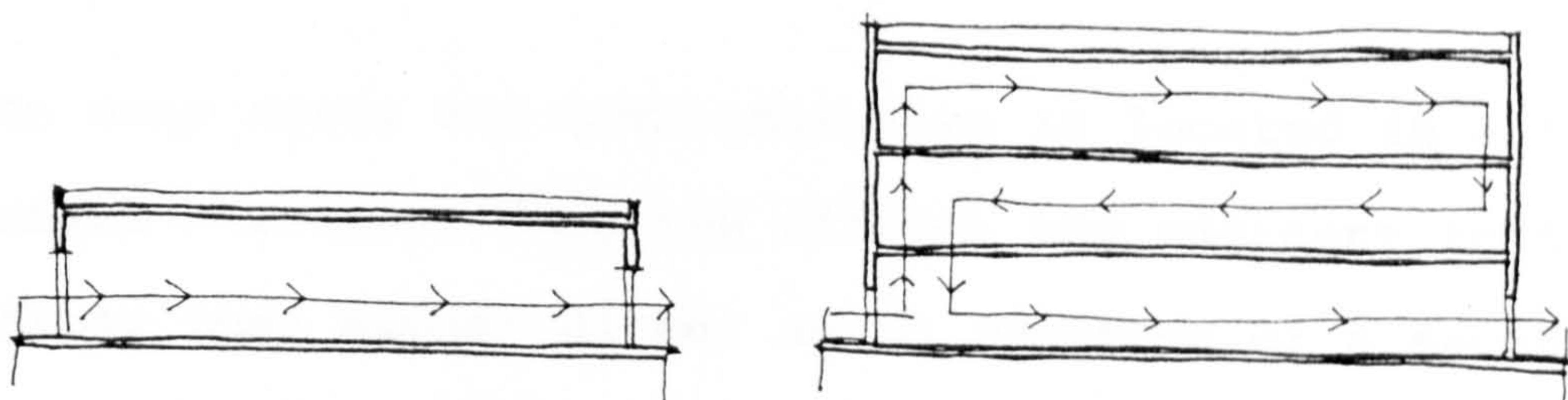


Fig. 185. Diagrammatic presentation of the two kinds of process

mainly by the length of machinery and the nature of the layout. There is not any written evidence about the arrangement of machinery in the early mills. According to the description of an industrialist²⁹ there were two layouts for spinning mills which are also analysed in the old catalogue of 'Brooks & Doxey Ltd, Makers of Textile Machinery'³⁰. In the first system the production line runs across the mill, whereas in the second along it, as is illustrated in the two similar plans of fig.186 .

In both cases the full length of ring spinning frames was put across the room due to the way power was transmitted, and to the illumination from side windows. The position of the engine room in all early mills is hard to determine exactly since most of the rooms have been demolished with the introduction of electric power. It can be assumed that it was either at the end or in the middle of the building. The only example in the sample where the exact position of the engine room is marked, is the SPINNING AND WEAVING MILLS OF EDESSA (A.4) .

In many cases the administration is located in a separate small building. When the offices are adjacent to the shop-floor they appear either as an addition of a second floor to the single-storey building or as a part of the second floor of a two-storey building covering the area which is facing the road and is close to the entrance of the site (fig. 187) . Accommodation of the raw material and the finished product do not constitute a separate building but

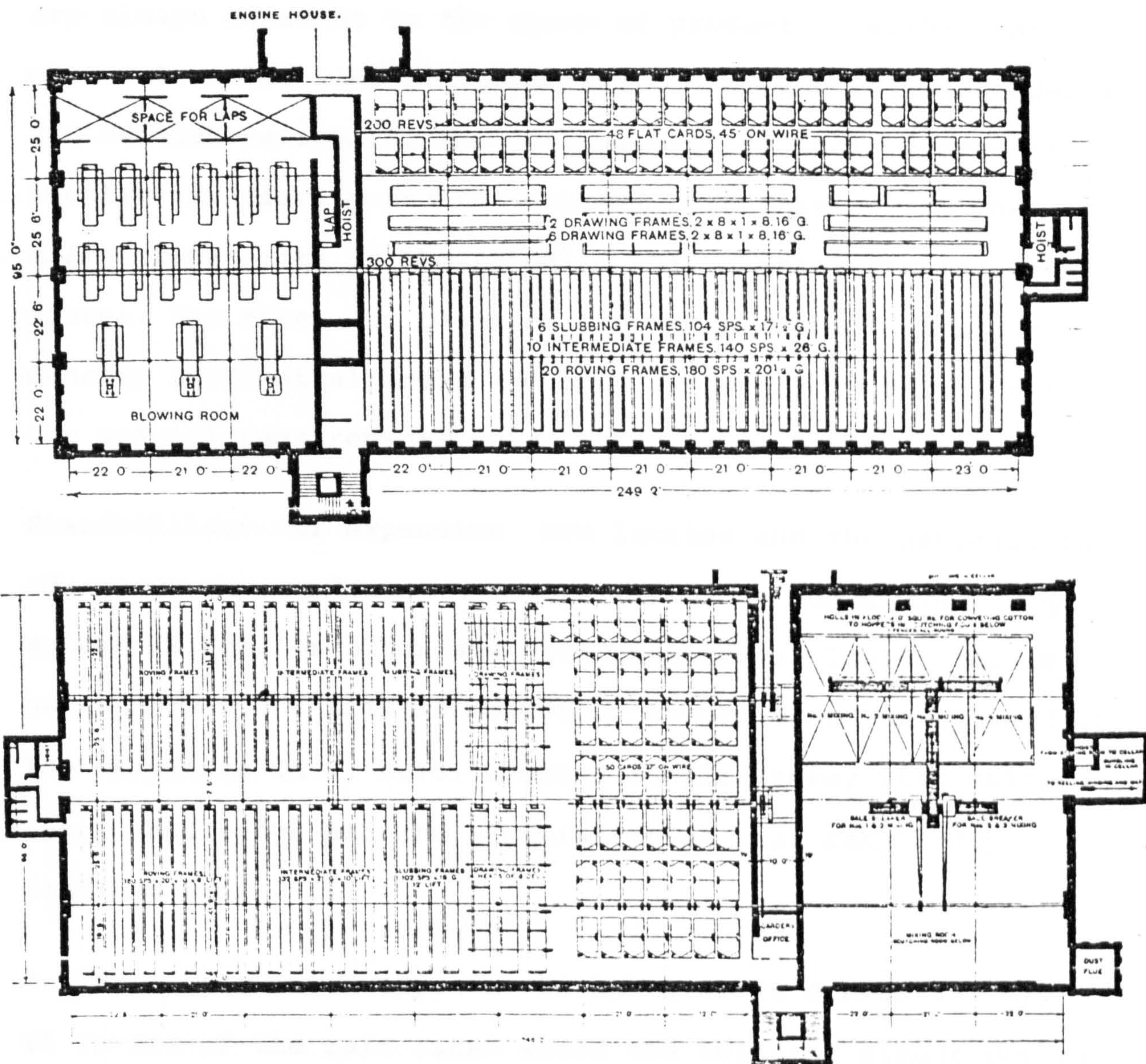


Fig. 186. Two typical spinning mills³¹

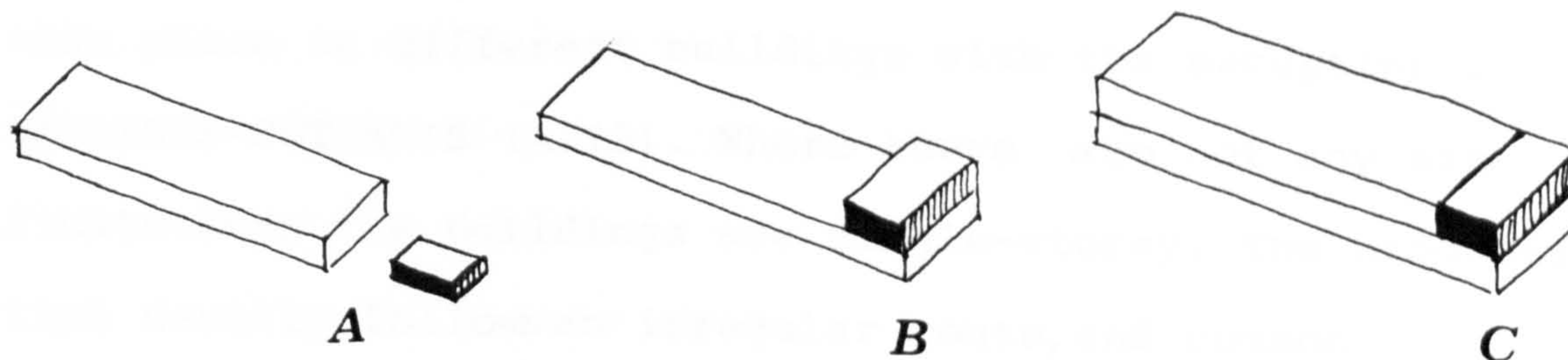


Fig. 187. Variations of the relationship between administration space and that of the shop-floor in Edessa and Naoussa

are always adjacent to the space of production within the main volume. The general characteristic of the mills of Edessa and Naoussa as regards the articulation of their spaces is simplicity, clarity and topological organization. In the mills of the city of Thessaloniki this characteristic is absent. The sites are parts of the urban network within high density residential areas and they are small in relation to the spatial requirements.

Possibilities for expansion are limited and the articulation of spaces is complicated. After successive expansions they appear as complex organisms with an internal logic that is not apparent, and time is needed to perceive and understand it. The complexes (A.7, A.16) combine single-storey with multi-storey buildings and the administration area can hardly be distinguished.

A similar situation appears in one mill in Athens (A.18). It is one of the rare cases where the building almost covers the site, and the complexity of the articulation of spaces is emphasized by the irregular form of the site.

In the areas of Athens, Piraeus, Patra and Lavrio, when weaving and spinning activities are combined, they usually take place in different buildings with the exception of MINAIDIS-FOTIADIS (A.15). Where there are not any site limitations the buildings are single-storey. The production line usually follows an irregular route, and common characteristics can be noticed only with difficulty. The administration in single-storey mills is either in a

separate building from the production hall (fig.188A) or is part of it and adjacent on its narrow side (fig.188B). In multi-storey factories administration is always within the main factory enclosure on the first floor (fig.188C).

Mills in the island of Syros exhibit similar plan characteristics to those from the area of Athens. Irregularities of the site has as a consequence irregularities in buildings which are not always visible from the outside, since the facades imply a simpler structure than that existing in reality. The provision of facilities for workers are not, apart from toilets, considered in the design of mills before the War. Facilities that now exist are mainly later additions.

After the Second World War a tendency develops towards the division of spinning and weaving activities, and this trend become marked after the mid '60's with the rapid development of the sector, and is due to economic reasons and market strategies.

Until the 60's buildings belonging to prosperous firms, and when they are constructed outside the big cities have a clear spatial layout resulting from the continuous production line. Their orderly articulation of spaces can be shown easily in the following diagrams (fig. 189). The width of shopfloors varies from 20 to 35 m with the exception of PIRAIKI-PATRAIKI'S firm (A.22) - the largest firm of the sector - which was 50 m. The other mills are combinations of single and multi-storey buildings which are either

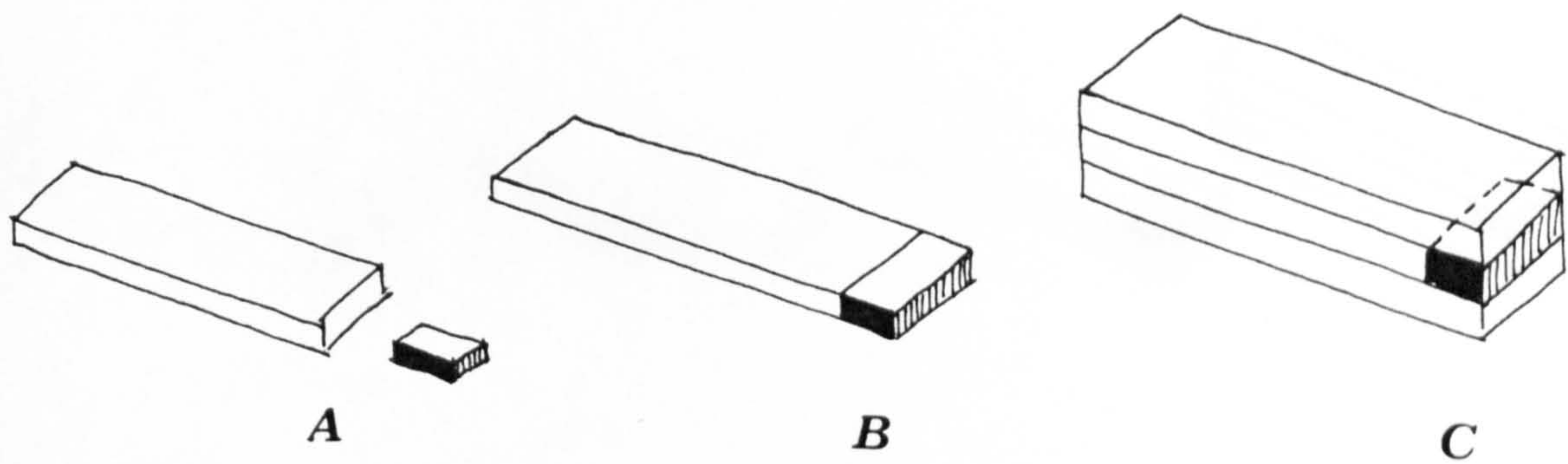
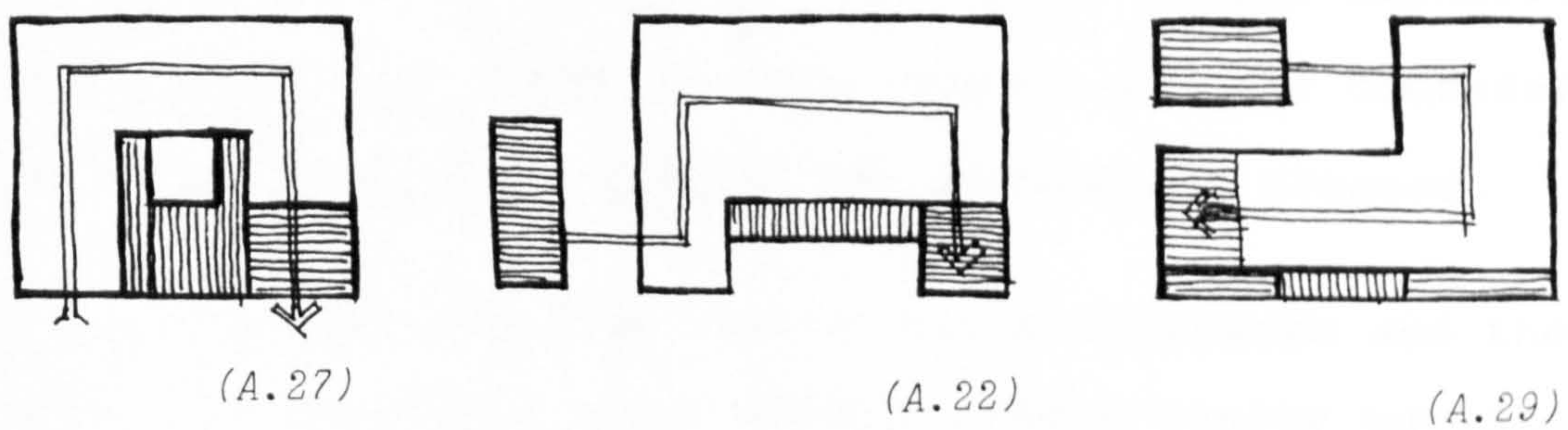



Fig.188. Variations of the relationship between administration space and that of the shop-floor in Athens, Piraeus, Patra and Lavrion



KEY

 production hall

 administration and workers facilities


 warehouses

Fig.189

separated or incorporated in a complex form. The production line is intermittent and unfolds on different storeys. The administration accommodation is not an independent building but it is attached in front of the shopfloor or enclosed within it (fig. 190).

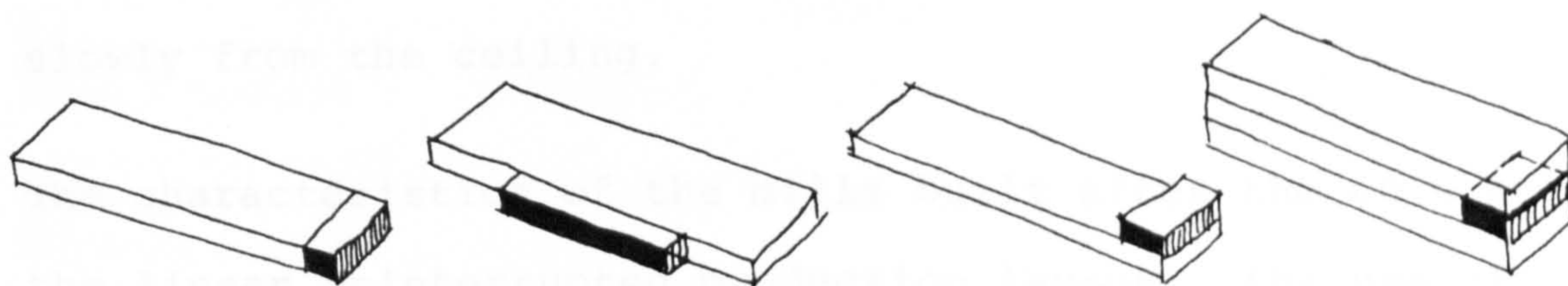


Fig. 190

Facilities for workers are still limited to toilets and lockers, and other amenities are completely absent. This can be explained by the fact that the owners are not legally bound to provide these facilities. They seem to be more interested in issues concerning production and auxiliary facilities - i.e. laboratories, repair shops, mechanical workshops etc - than in their workers who are considered as an insignificant part of the production process.

After the mid 60's the size of mills increases and these later constructions are oblong, single-storey buildings with width varying between 50 and 92 m. However, five mills out of 57 of the sample are multi-storey; they belong to old firms which have reconstructed their premises on the old sites which are relatively small and within the urban network. The only mill which is constructed for functional reasons as a two storey building is VERLAN (A. 57).

The idea which generated this form is very simple: the fabric is woven by the looms on the first floor, then it

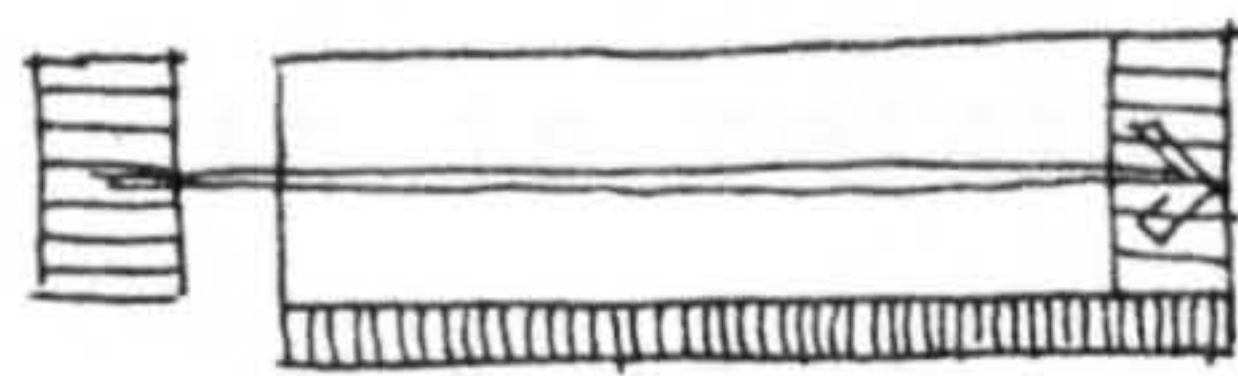
comes down very slowly to the ground floor through openings in the floor and it is wound around the beams which are arranged on the ground floor. This method has two advantages: the production of a long continuous fabric, and the quality control of many fabrics simultaneously as they come down slowly from the ceiling.

The characteristics of the mills built after the 60's are: the linear uninterrupted production layout, the use of air-conditioning and the provision of more facilities for workers. These are wet services, lockers and catering facilities; other amenities are rarely provided. The following figure (fig. 191) illustrates diagrammatically the simple layout of single-storey buildings.

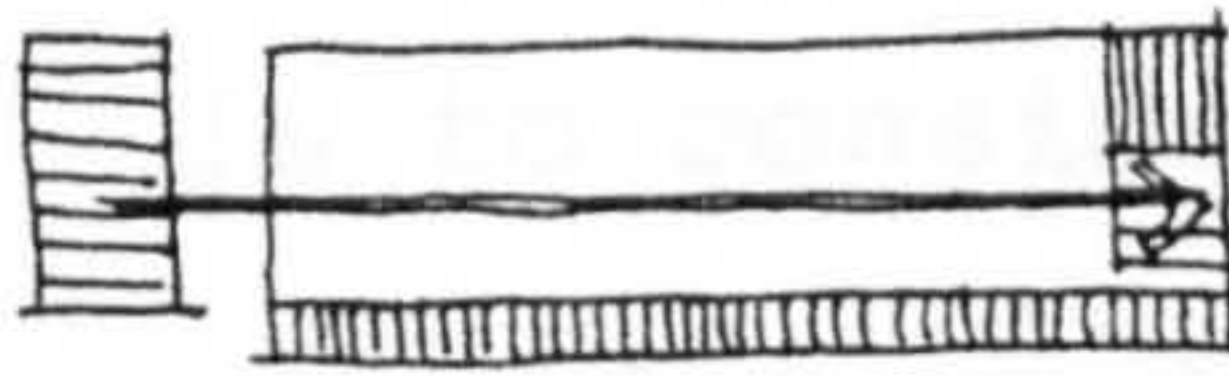
Large firms prefer clear zoning of spaces, a linear production line which runs along the building, and the consequent oblong form of their building volume (A1,2, B1, C1,2, D). Smaller firms tend to apply more complex articulation of buildings due to the size and shape of their sites. In multi-storey mills a more or less linear process is followed which is distributed to various levels. The offices and facilities for workers are always incorporated in the factory enclosure usually on the first floor.

3.3. CONVENTIONAL APPROACH AND TYPOLOGICAL ANALYSIS

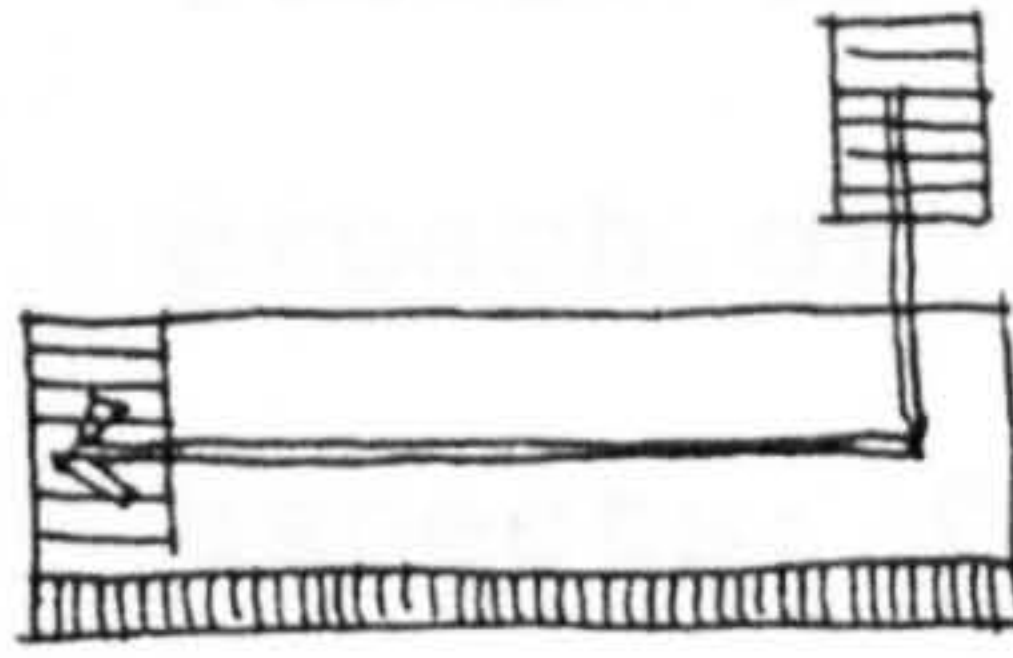
The descriptive analysis of mills in Greece which has been conducted so far, exhibits a number of particular characteristics. It refers to the phenomenal level, and thus



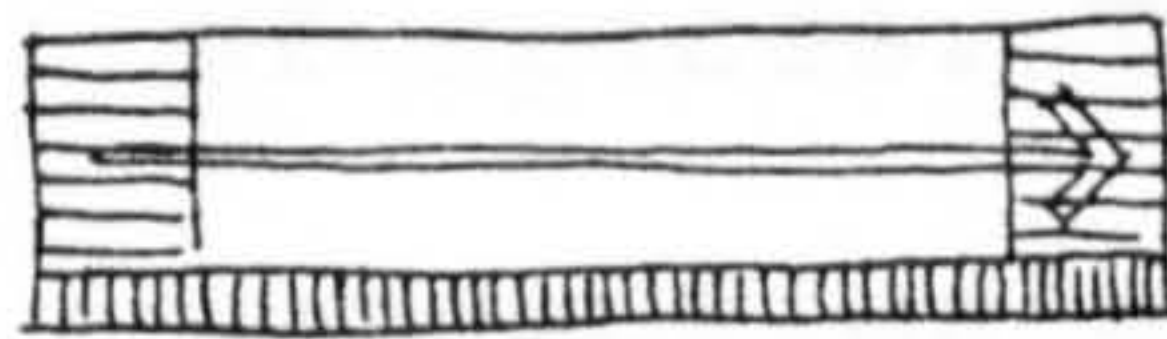
A₁(6)*



A₂(1)

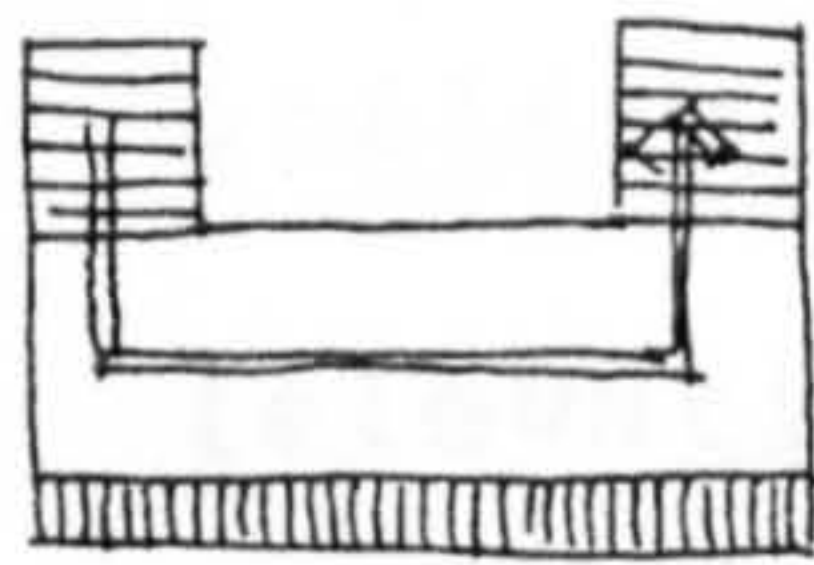


A₃(1)



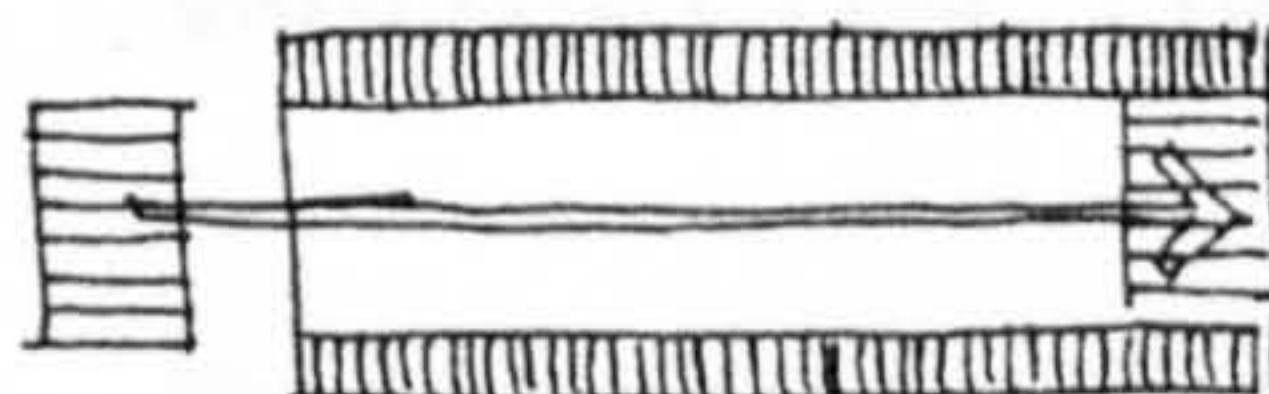
B₁(8)

linear-shape

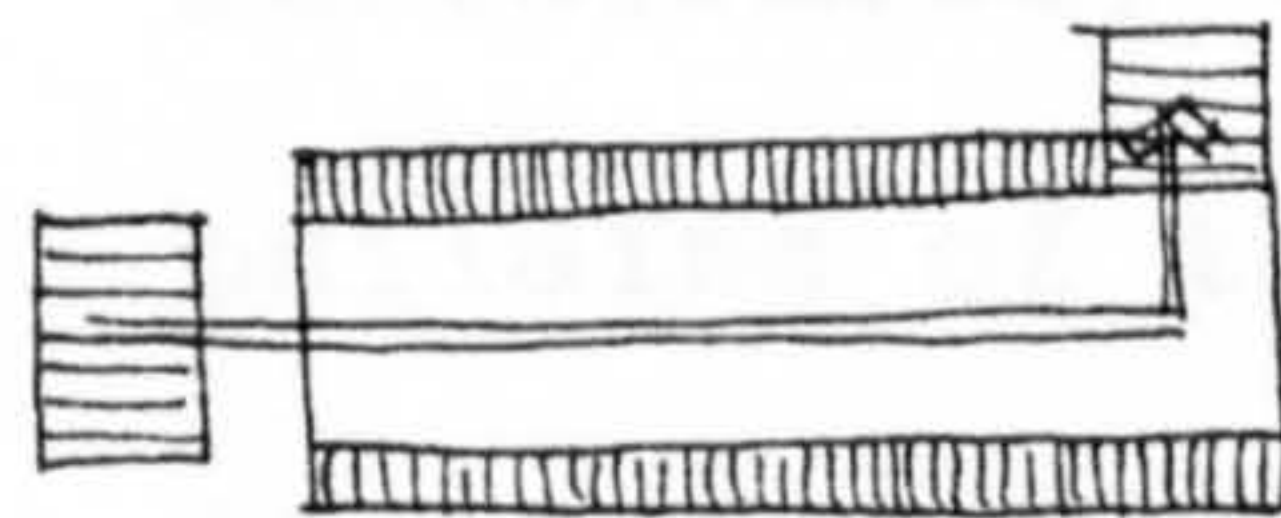


B₂(1)

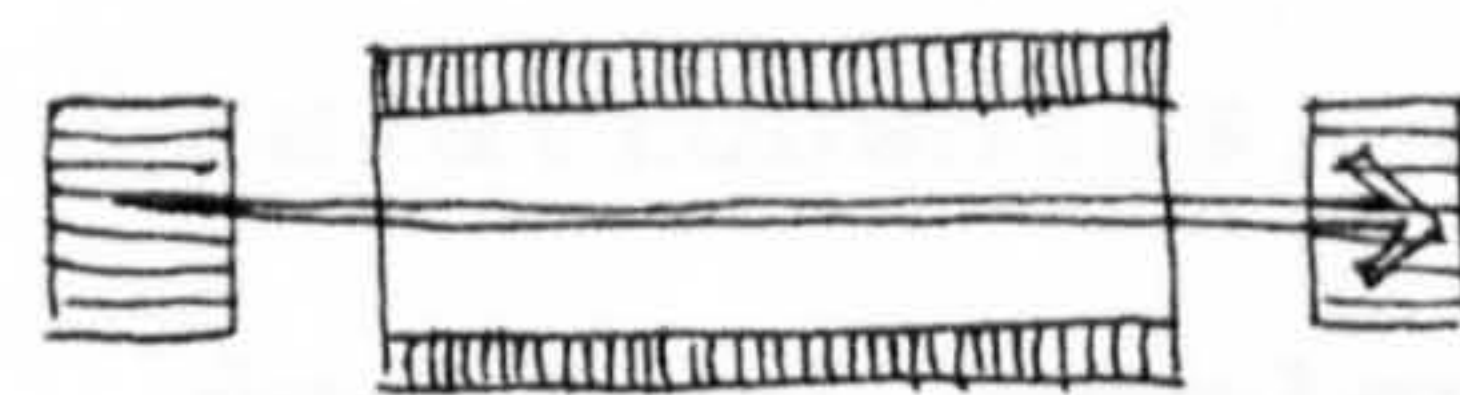
U-shape



C₁(3)



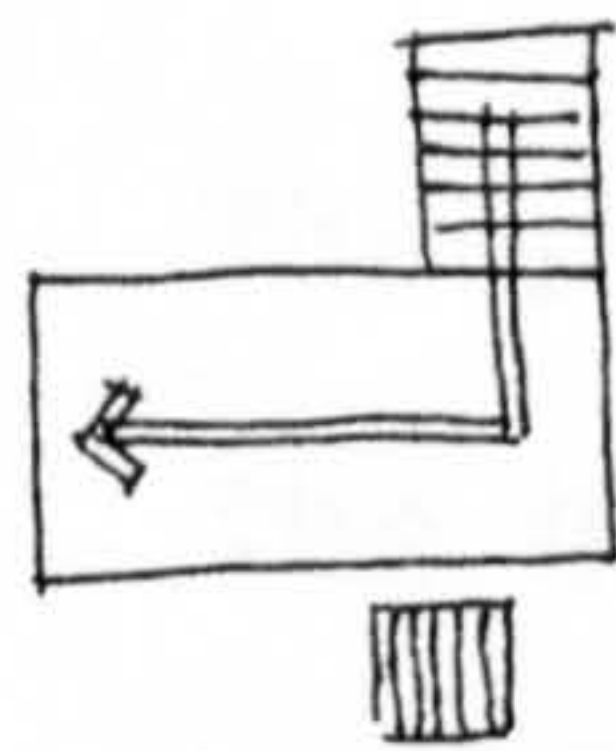
C₂(1)



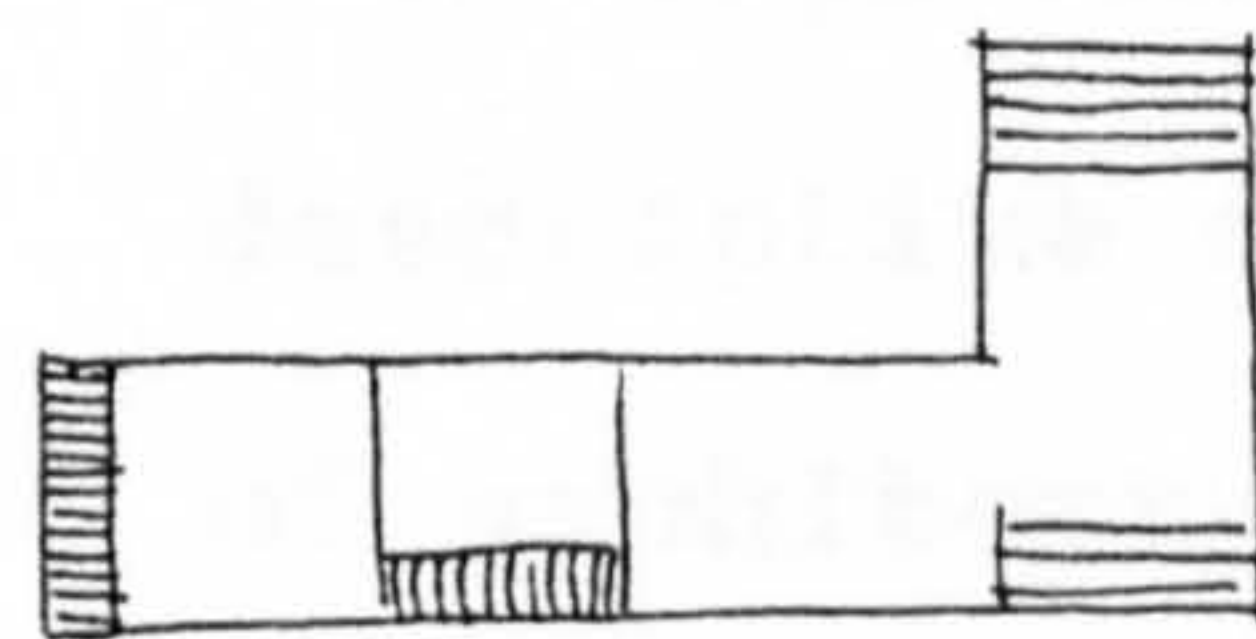
D₁(1)



E₁(1)



E₂(1)



F₁(1)

The warehouse for raw materials is a separate building. The other activities are combined in one spatial volume and are articulated in two zones. One zone for the shopfloor and one for the administration, facilities for workers, auxiliary services, air-cond. instal. Expansion potential in two directions

All activities take place in one building and are organized in two zones. The only difference from A is that the warehouse is not an independent building

Two spatial volumes like A. The activities are articulated in three zones. Expansion potentials in one direction

Three spatial volumes and tripartite articulation of the activities. Limited expansion potentials

Two spatial volumes. The administration is an independent building. The shopfloor has not an oblonged shape but a rectangular one.


An L shaped complex which is the result of many successive additions. A clear flow diagram can not be drawn due to the complexity and variety of the products.

Fig.191

KEY

 production hall

 administration and workers facilities

 warehouses

*The number in brackets indicates the number of cases of the sample which belong in the category

it is related to the external, formal and observable features of buildings. Although the main endeavour of the analysis is to consider buildings as a whole and not to restrict itself to a kind of facadism, it necessarily employed an approach of fragmenting the buildings into three constituent aspects: formal language, structural system and articulation of spaces. These subdivisions depart from the three categories established by Vitruvius: *venustas*, *firmitas* and *utilitas*, and are related to the designers' conceptual tools (elevations, sections and plans) for considering and communicating the three-dimensionality of buildings.

Furthermore, the analysis has focused on nearly every building of the sample and discussed its individual features. It is founded on individual dispositions, information and relationships, and consequently it is not free from the detailed complexity of the actuality which is exaggerated by the fact that the number of buildings under study is large.

The problem that arises is both quantitative and qualitative. The quantitative aspect is related to the large number of buildings which constitute an unmanageable amount of descriptive data. The qualitative aspect is that knowledge of architectural phenomena cannot only be derived from knowledge about individual buildings; it refers to the method of describing and interpreting. Interpretation in architecture presupposes, apart from description, comparison - a connection of the events, and also the disclosing of

their causes and meanings. Thus, interpretation involves interrelation. As. H. Bonta claims "interpreting an edifice amounts to classifying it - recognizing a set of characteristics of the building which can also appear in other works of architecture and which thus determine the class"³².

Every building is either a replication or a variant of something made before and very rarely can be a revolutionary invention. The consequent similarities of buildings can be attributed to their common functional or genetic origin. It is obvious that buildings which are designed to fulfill the same functional objectives possess a large number of characteristics in common. In this case the buildings are considered to derive from the same functional origin. Common traits can be observed in buildings whose designers are influenced one from the other or rely on the same body of principles, rules or canons. These buildings can be regarded to have the same genetic origin.

Historical analysis, which seeks to describe and explain buildings, should relate them to their particular antecedents, and should start from individual cases and work outwards to their common features and overall characteristics.

Considering the view of Max Weber - related to the historical analysis of social phenomena - that the only means of analysing and mastering complexity is the discovery of the laws of the events, it is assumed that it is important to disclose the common underlying principles of buildings as they are expressed through their common formal similarities.

Architectural history has employed, so far, various methods

of discovering formal sequences and bracketing historical phenomena by basing them upon styles, schools, architects-creators, types etc.

This work seeks to assess the typological method by examining its relevance and utility for the description of mills. The reasons for this are; first, the objective fact that industrial buildings in general and mills in particular have not been subjected to conventional stylistic analysis or to analysis according to schools or architects, since the majority are ordinary buildings designed primarily in response to strictly functional requirements and their designers are usually unknown. The second reason is more subjective and is based on the view that the stylistic approach is less comprehensive and more formalistic than the typological, and therefore is less productive of useful information and understanding.

The typological analysis of the evolution of buildings focuses upon the formal elements and their underlying ideas which are common to a group of them and are constant for a certain period. This network of constant attributes which is free from the circumstantial features and details of individual cases, is the formal expression of a particular design problem derived from human needs, and occurs within cultural, social and historical contexts. However, the typological approach is complementary to the 'full-description'³³ approach, since the former discloses the beginning and the end of the threads which connect architectural events, whereas the latter focuses upon

individual buildings.

An important feature of the typological approach is that it allows cross-regional and inter-temporal analysis. A conventional descriptive process would follow a more or less linear path in time starting from the earliest buildings to modern, moving from region to region. Typological description focuses upon the sequential grouping of buildings on the basis of their common aspects and ideas without taking into account, at least in the first place, issues of regional and temporal coexistence. Thus, typology is not determined by external factors (historical time and geographical environment), but by the buildings themselves. The typological analysis segments history on the basis of the object of architecture - the building - and is not guided by the conventional divisions of history conditioned by socioeconomic happenings. It is mainly concerned with the origins of the form of the buildings, their life span, their propagation, change, obsolescence and succession in a given historical and social context. The next chapter provides a systematic background for the discussion of issues involved in using a typological approach.

CHAPTER 4

THEORY AND APPLICATION OF TYPOLOGICAL ANALYSIS

INTRODUCTION

This chapter has a predominantly theoretical orientation since it deals with issues concerning the nature and characteristics of the notion of type, and also with the use of typology as a descriptive and prescriptive tool in architecture. Its purpose is to arrive at firm conclusions regarding the application of typological analysis to the case study of the thesis.

The first section of the chapter (4.1) contains a discussion of the philosophical issues involved in the typological approach concerning the nature and value of types by focusing on the distinction between typology and classification. This has important methodological implications.

The second section (4.2) analyses a number of views developed in architecture in an effort to explicate the meaning of type, and it displays a number of issues regarding the nature of types, which will be evaluated and criticized in due course (chapter 7) after the typological analysis of mills. The section sets out the historical and contextual transformations of the notion of type in architectural thought from Vitruvius to the recent ideas of the neorationalists. Architectural thought encompasses four distinct areas: history, theory, criticism and design. The concept of type has been used in these domains, whether explicitly or not, as a topic for study, as a taxonomic tool for description and explanation of artefacts and as an operative instrument in design. The views which are presented cover all these areas and are analysed in chronological order. The ap-

plications of typology to architectural analysis are described separately at the end.

The third section (4.3) illustrates the meaning of the notion of type and the fundamental distinction between typology and classification by referring to views developed in the biological sciences and archaeology. These particular areas have been chosen, because they are the main sources which have influenced the formation and use of the notion of type in architecture. Archaeology is picked out for the additional reason that as a discipline it shares some features with architecture.

The fourth section (4.4) deals with the potentiality of a practical application of typology to historical analysis in architecture and mainly with the process of identifying types in a given sample of buildings.

4.1. THE NOTION OF TYPE AND THE RELATIONSHIP BETWEEN TYPOLOGY AND CLASSIFICATION

The notion of typology has played an important role in the development of a number of disciplines: biology, mathematics, history, sociology, anthropology, linguistics, archaeology and architecture. In every case typology is considered either as a topic of study or as a methodological device and an explanatory tool.

The word typology in its literal original meaning from the Greek τυπολογία (typologia) means the study or science of types, or study based on types. The root of the word type is derived from the Greek τύπος (typos)¹ which means imprint, impression, character, figure, and the Latin word typus, which means image.

The present meaning of the term is closer to the Latin typus and is, according to the Oxford English Dictionary, "that by which something is symbolized or figured; anything having a symbolical signification", or "a figure or picture of something, a representation; an image or imitation"², or as well "the general form, structure or character distinguishing a particular kind, group or class of beings or objects ... after which something is made"³. However, the concept of typology is often confused with the notion of classification. Both terms represent key methods in apparently diverse fields of enquiry. Though both originated from the same need, they are different. Their difference lies on the principles and criteria selected to determine the final groupings. These principles depend, to some degree, upon the scientific domain involved.

The purpose of typology and classification in various

disciplines is to enable the scientist to make inductive generalizations concerning the material he is investigating when it appears to be various and complex. In other words, both methods imply a procedure which extends beyond individual situations and seeks to abstract and generalize. The logic of classification and typology lies in human cognition and the way man perceives the external world and tries to bring order to what he observes. Both are methods of organization employed to apprehend the world.

In all disciplines, despite their differences, classification means any act of arranging, sorting and designating perceptual or non-perceptual objects in groups based on their similarities and differences, according to certain selected criteria which refer either to their morphological or to their structural characteristics. Typology is more specific and refers to a division of an assemblage of objects into groups based on similarities that they possess as manifestations of the same principles.

Furthermore, typology transfers the level of description from the actual, superficial level, to a deeper and abstract one, and seeks to reveal these characteristics which have been constant for a certain period of time. Taxonomists by devising types try to disclose through the material reality its generative principles.

The most important issue which underlies the difference between typology and classification is that the holistic properties of the notion of the type, which is opposed to the

fragmentation of individual entities introduced by classification. Classification is more concerned with some aspects of the phenomenal level of objects, and is based on criteria selected by the analyst to serve his purpose, *a priori* problems and hypotheses. Thus, class identification is made on the basis of fragmenting the objects. Typology on the contrary, refers mainly to an abstract level which is beneath the observable form, and considers the form as a whole entity. Its aim is to discover the principles which lie behind the measurable artefacts and reveal themselves through the formal structure. Furthermore, it examines changes in these principles and ideas as well as their origins⁴.

The process of identifying types is very difficult and complex, because every process of knowledge is complicated due to various factors involved - concerning either the 'object' or the 'subject' - and also because it focuses not only on the perceived material reality as such, but on the principles behind it, and also because it tries to grasp the reality as a whole. There can be many equally good classifications of a group of objects. Every classification depends on the taxonomist and the taxonomic criteria he chooses according to his interests.

Despite the difference between the notion of type and class, very often a classificatory view lies behind methods which are considered as typological. This is common when terms are employed without their meaning being explicated and evaluated from the outset. This ambiguity is also present in architectural discourse, where the problem of the relation of classification

and typology has not been stated and discussed openly, while underlining a number of typological views.

The notion of type in architectural thought has evolved from implicit expressions in the treatises of the classicists to explicit statements in the works of some modern architectural writers. The concept of type is always connected in some way with the notion of imitation. Various typological views, after the middle of the eighteenth century, regarded the notion of type in relation to an imitative role of architecture. The object of mimesis has been considered to be nature (M.A. Laugier, Quatremère de Quincy), the qualitative characteristics of industrial mass-produced machines (Modernists) or architecture itself (J.N.L. Durand, Neorationalists, A. Colquhoun).

Two categories of approach to typology may be distinguished: the 'active' and the 'passive'. The first encompasses these views which attribute to type an operative role either as a descriptive tool or as a guiding principle in design.

Descriptive approaches are expressed, in most cases, using a conception of type which approximates the notion of class.

A typical classificatory approach is exemplified in the work of J.N.L. Durand, the recent work of Rob Krier and the majority of the so-called typological analyses carried out in the field of vernacular architecture.

The second category of approach to typology (i.e. the 'passive') includes views that have more the character of explanation than of prescription. This approach is exemplified in the work of Quatremère de Quincy and in the more recent

work of Alan Colquhoun and B.V. Hillier *et al.*

Despite the fact that a great number of diverse views have been developed in architecture to explicate the concept of type and justify its use in description or/and design, a general conclusion can be drawn for the meaning and nature of the type. The type describes and represents a group of buildings which have certain common formal characteristics derived from the same ideas and principles. Each type is defined by a specific and cohesive combination of features which refer to the building as a whole. The type expresses the structural pattern beneath the actual form and reveals itself through the formal structure of buildings. It originates from certain ideas and views which are products either of culture or of economic and social conditions and are spread in space and in time. Thus, types are dynamic and are subject to continuous change. By definition there should be one correct type division of a given body of buildings, since the ideas, the views and the principles which generate them are certain and concrete. On the other hand, there can be many equally good classifications of the same group of buildings, as for instance the groupings of buildings according to the shape of their plan (rectangular, L-shaped, U-shaped and so forth plan), or according to their structural system (load-bearing, skeletal buildings), or even according to their functions (hospitals, schools, houses, factories etc). These groupings constitute classes rather than types.

The true typological approach represents an attitude towards architectural analysis which is opposed to that of

classification. The difference between them is in the manner of choosing and applying taxonomic criteria, and is expressed as opposition of the holistic approach to analysis.

The distinction between typology and classification in general underlines the relation of 'building class' and 'form type' in architecture⁵. The term 'building class' will be used to refer to the labelling of buildings as offices, houses, factories, schools, hospitals and so forth which have a common function. In other words, buildings of the same class shelter the same dominant activity determined by a certain social need. 'Form type'⁶ will mean a set of common features that characterizes an assemblage of artefacts belonging perhaps mainly, but not necessarily to the same building class, which are manifestations of the same genetic principles and ideas. 'Form' is used with a broad meaning and does not speak of only the physical shape, size and mass of the building (in other words its geometry), but also of all the elements (space, mass, surface) that constitute its structure, their compositional rules and the means through which they obtain an expressive quality, which are scale, light, colour, materials etc.

Apart from the major issue which is the meaning of type and the fundamental distinction between the concept of type and class, there are a number of important themes which are related to the nature, significance and use of type as descriptive and prescriptive tool in architecture. These are: the pattern of life of every type, the particular conditions under which a new type emerges and an old one terminates, the

connection between successive types, the relationship between coexistent and concurrent types, and the use of types as operational tools in design.

These important problems have not been brought forward for debate in architectural discourse as is shown in the review analysis of the following section (4.2), apart from the last one. In contrast, in other fields such as archaeology the typological debate, which has been conducted for several decades now, has centred mainly around these basic problems.

However, it is rather difficult to come to concrete conclusions and generalize the answers to the above issues as given in other fields of enquiry, and to expand them to architecture. Since the aim of the thesis is to investigate all dimensions of typological analysis, these fundamental themes are analysed and discussed in due course in chapter 7 in concrete, factual terms in the light of the results of the typological analysis of mills.

4.2. THE NOTION OF TYPE IN ARCHITECTURAL THOUGHT

The various views, which are presented in this section, may be considered as belonging to two major trends in architectural thought; the classical which lasted till the middle of the eighteenth century, and the modern one.

Early views of the concept of type

The notion of type was explicitly introduced into architectural discourse with the emergence of modern thought in architecture. Till then there were only typological allusions in

the various architectural treatises resulting from the canonical spirit of the era. Classical thought from Vitruvius till the middle of the eighteenth century, moulded by the ideas of Platonic and Pythagorean philosophy, believed that beauty was inherent in the artefacts which were designed on the basis of proportions derived from the human body, music or nature, which also expressed the celestial universal harmony. The strict canons, the fixed rules and ratios that should be followed, enriched with symbolic meanings, led inevitably to the acceptance and design of certain limited types.

Thus, the various treatises offered, apart from general instructions for synthesis, types of buildings as the only possible and acceptable solutions to be followed in design. Vitruvius's classification of Temples (fig. 192), Alberti's proposals for the sacred edifice⁸, or Palladio's typological mind in the design of his villas⁹, were expressions of this general spirit. Palladio's way of working by using certain types has been discussed by R. Wittkower who stressed that "once he had found the basic geometric pattern for the problem villa, he adapted it as clearly and as simply as possible to the special requirements of each commission"¹⁰. (fig. 193)

Classical thought inevitably led to the production of architectural artefacts that can be characterized as representations of certain form types. The reason for this is that the architect's repertoire in terms of building classes was very limited and the form types they could choose were strictly determined by canons.

The Enlightenment architect was searching for the origins and

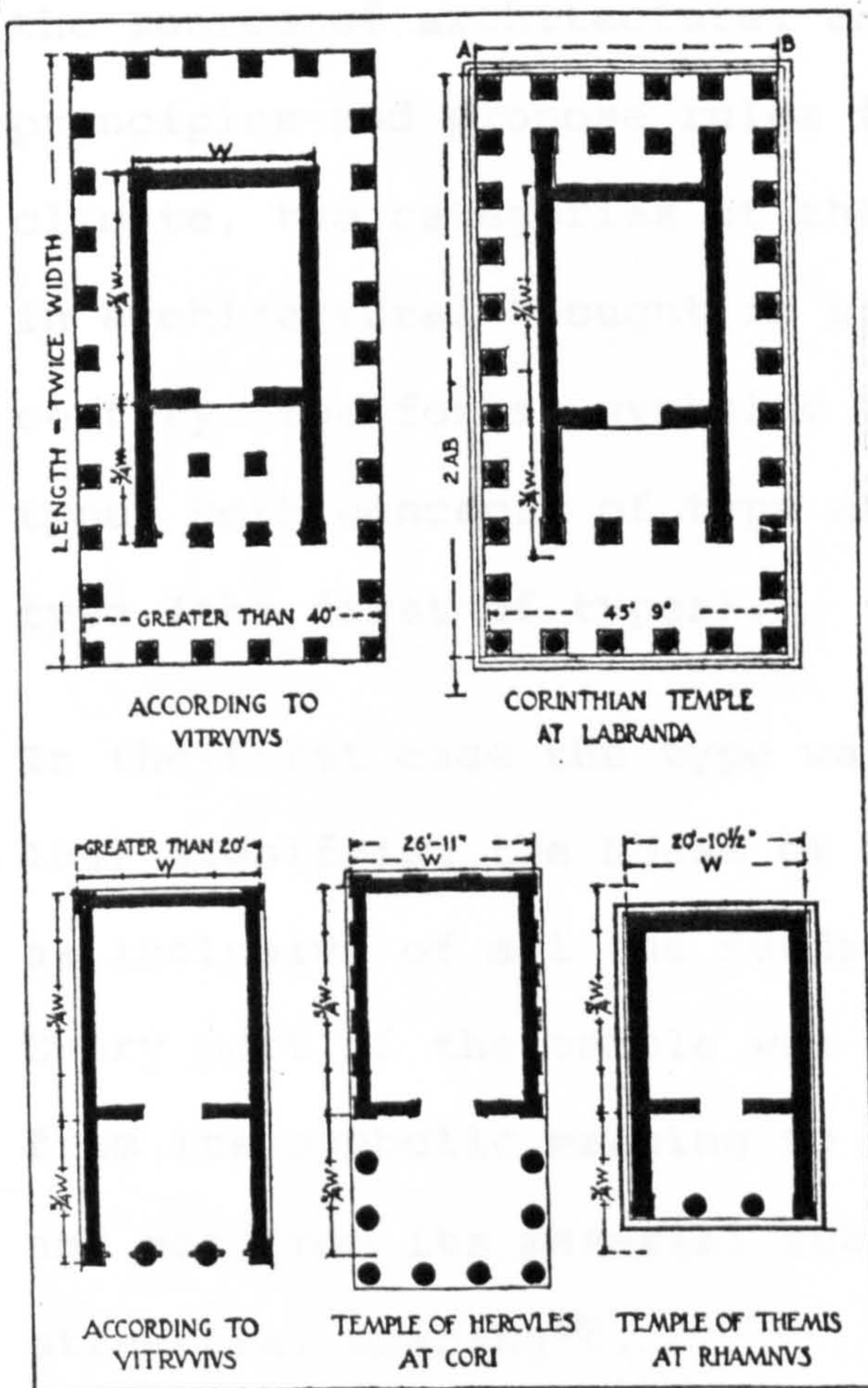


Fig. 192. 7

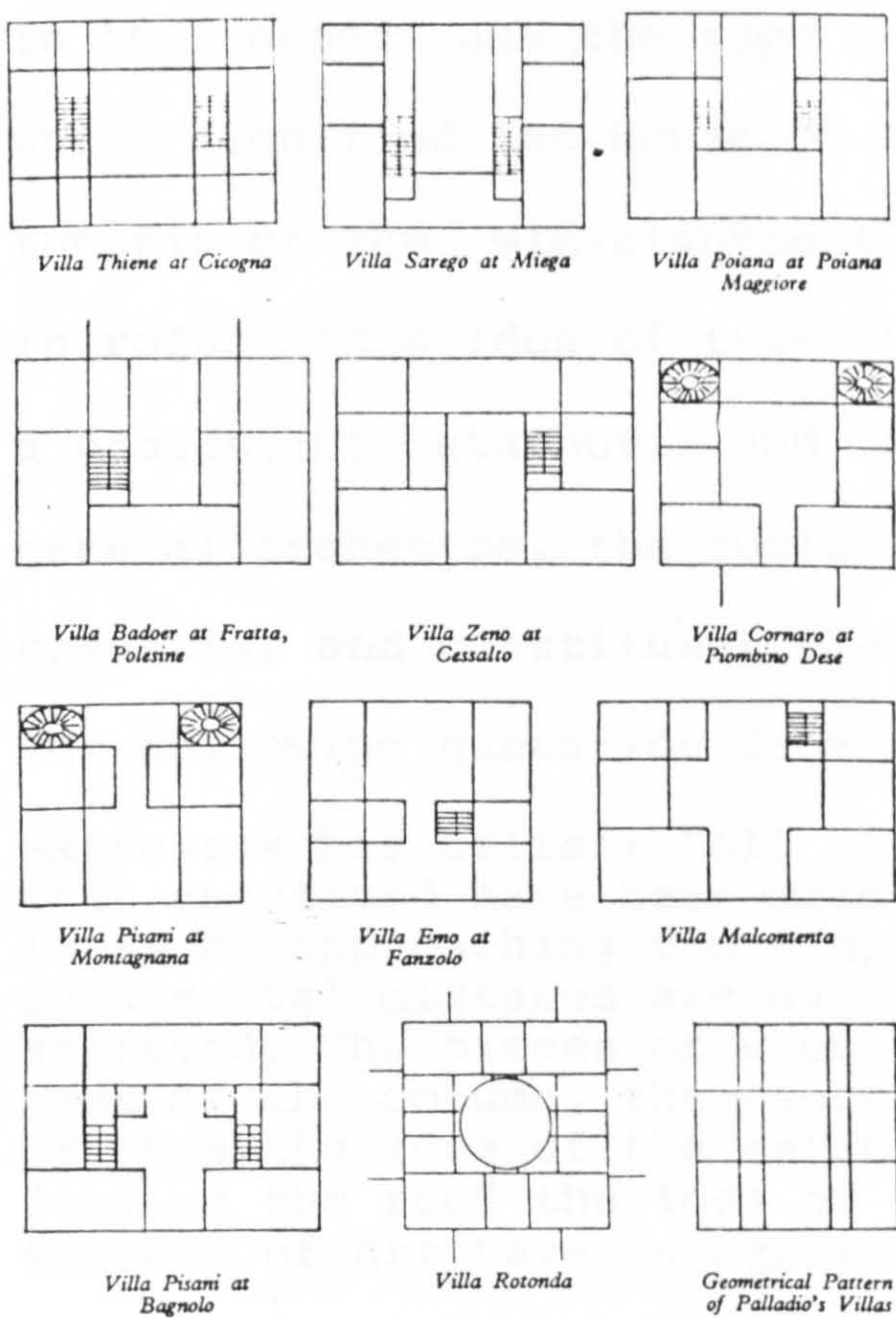


Fig. 193. R. Wittkower's schematized plants of eleven of Palladio's villas 11

the source of architecture, and was trying to establish principles and propose rules for the design. Within this climate, two categories of the notion of type were introduced in architectural thought in the second half of the eighteenth century. The formal-symbolic type and the structural-functional type. Both concepts of type are close to the idea of archetype (the first of types).

In the first case the type was the Temple of Solomon (fig. 194) signifying the House of God. The Temple was considered as inclusive of all the fundamental elements of architecture. Every part of the temple was deemed to possess a value derived from its symbolic meaning to express the celestial harmony, and not from its material substance and functional or structural meaning¹³.

In the second case the type was the primitive hut (fig. 195) which signified the House of Man. The Abbé Laugier, a theorist of the mid-eighteenth century was the first to introduce this idea of type. He considered architecture as a process of metaphoric and imaginative imitation of a general archetype, the rustic hut, which included all the essential and constituent elements of nature and architecture. The following quotation from his 'Essai sur l'architecture' expresses this belief: "All the splendours of architecture ever conceived have been modelled on the little rustic hut... It is by approaching the simplicity of the first model that fundamental mistakes are avoided and true perfection is achieved. The pieces of wood set upright have given us the idea of the column, the pieces placed horizontally on top of them the idea of the entablature, the inclining pieces, forming the roof the idea of the pediment. This is what all masters of art have recognized"¹⁵. Laugier's idea is similar in character to Goethe's conception of the archetypal plant



Fig. 194. The Temple of Solomon. From an anonymous manuscript of the Freemasons¹²



Fig. 195. M.A. Laugier's rustic hut. Frontis piece of his 'Essai sur l'architecture'.¹⁴

**PAGE
NUMBERING
AS ORIGINAL**

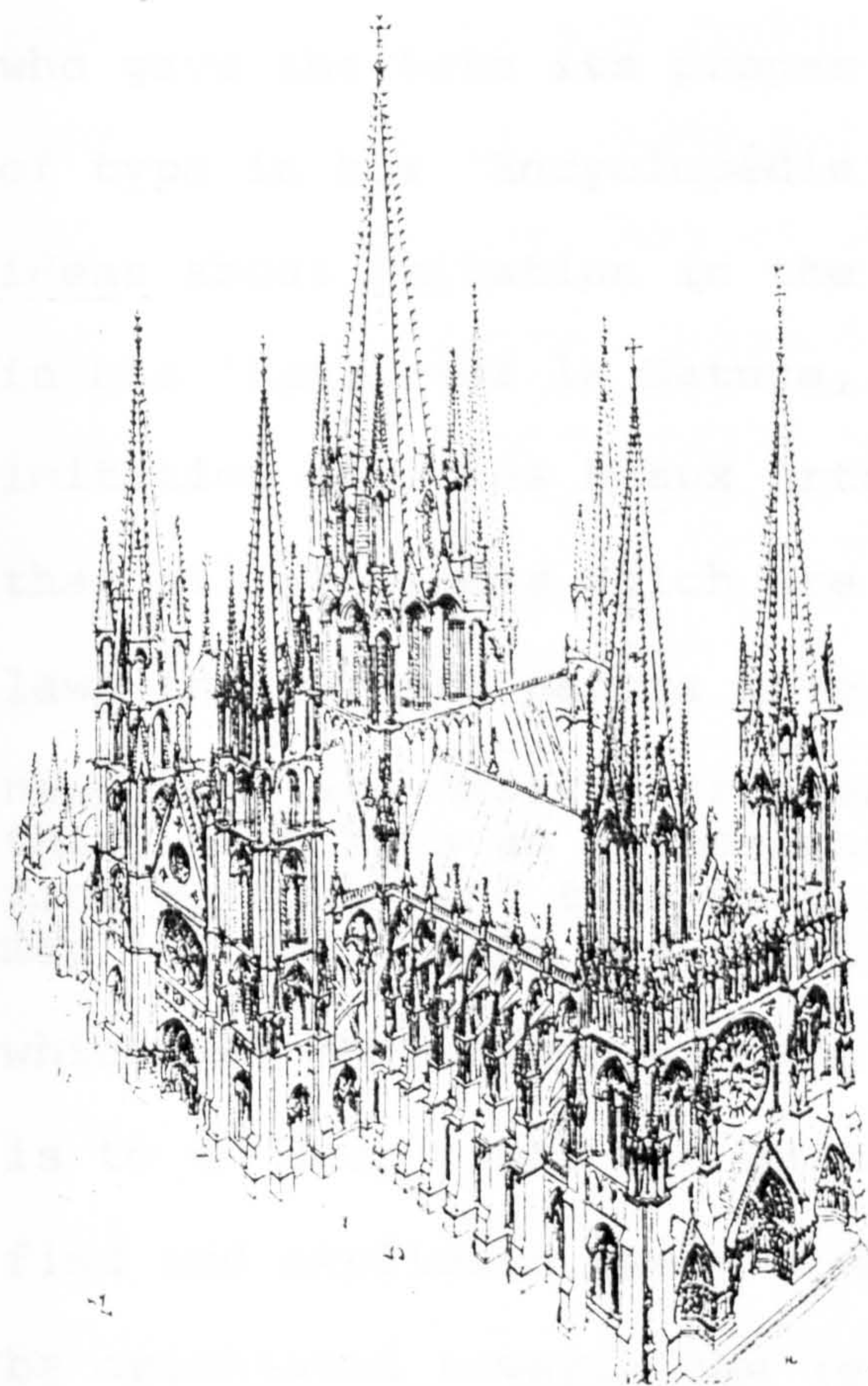


Fig. 196²²



Fig. 197²³

Although Viollet-le-Duc's types are reminiscent of Goethe's notion of *Urpflanze*, his conception was different, because the purposed types have been designed for the economy of description and without the presence of theoretical arguments to justify his particular choice.

Type and metaphoric imitation

The first coherent and integrated formulation of the idea of type in architecture was developed by Quatremère de Quincy who gave the term its proper meaning. Quatremère's definition of type in his 'Encyclopédie Méthodique'²⁵ reflected his ideas about imitation in the fine arts which were presented in his 'Essai sur la Nature, le But et les Moyens de l'imitation dans les Beaux Arts'²⁶. His fundamental idea was that all artefacts which are products of imitation of the laws that govern nature have a common preexistent source. All new forms are derived from existing forms. As he wrote "everything must have an antecedent. Nothing in any genre comes from nothing, and this must apply to all the inventions of man"²⁷. Thus, type was for Quatremère the preexistent seed which was the origin and the primitive cause. If our purpose is to go deep under the surface of observable form and to find and explicate their common genetic sources we have to be orientated towards the identification of type. Concerning the ways which lead to the discovery of the original principle of the formation of architecture in different countries, he wrote that they are "rooted in the nature of each region, in historical notions and in the monuments of the developed art themselves"²⁸.

Understandably, Quatremère, in order to avoid misinterpretations of his concept of imitation, explained the kind of imitation he proposed as a moral one, in other words as a

metaphoric imitation. According to J.C.Kent²⁹ moral imitation is that which procures us moral enjoyment and signifies no more than the opposite of the material and sensual. Quatremère defined it more analytically as "imitation by analogy, by intellectual relationship, by application of principles, by appropriation of manners (styles), combinations, reasons, systems etc"³⁰. The most important contribution of Quatremère to the development of the concept of type was the distinction he made between type and model. Although the two terms are often taken to be synonymous, they are different to the extent that the former includes the notion of metaphoric imitation and the latter the idea of formal and exact imitation. The type, as Quatremère stressed "presents less the image of a thing to copy or imitate completely than the idea of an element which ought itself to serve as a rule for the model ... The model as understood in the practical execution of the art, is an object that should be repeated as it is, the type, on the contrary, is an object after which each (artist.) can conceive works of art that may have no resemblance. All is precise and given in the model; all is more or less vague in the type"³¹.

At the end of his definition of type Quatremère referred to the relationship between type and needs, in other words, between form types and building classes. He demonstrated that each building should be a manifestation of a certain type, selected by the architect; this type should be derived from its uses and from the aim to attain a form with a particular character or physiognomy.

Classificatory notion of type

The work of J.N.L.Durand, at the beginning of the nineteenth century, marked a shift towards another approach to typology. The aim of architecture was, for Durand, not the imitation of nature and through it the attainment of pleasure and artistic satisfaction but "*l'utilité publique et particulière*,

la conservation, le bonheur des individus, des familles et la société"³²[public and private utility, the preservation and happiness of individuals, families and society] .

The means that architects should employ to achieve their purpose were argued to be convenience and economy and the general principles related to these were, respectively, solidity, salubrity and comfort, and symmetry, regularity and simplicity. Durand criticized Laugier and Vitruvius and rejected the idea that architecture was a process of imitation either of the rustic hut or of the human body. As he wrote,

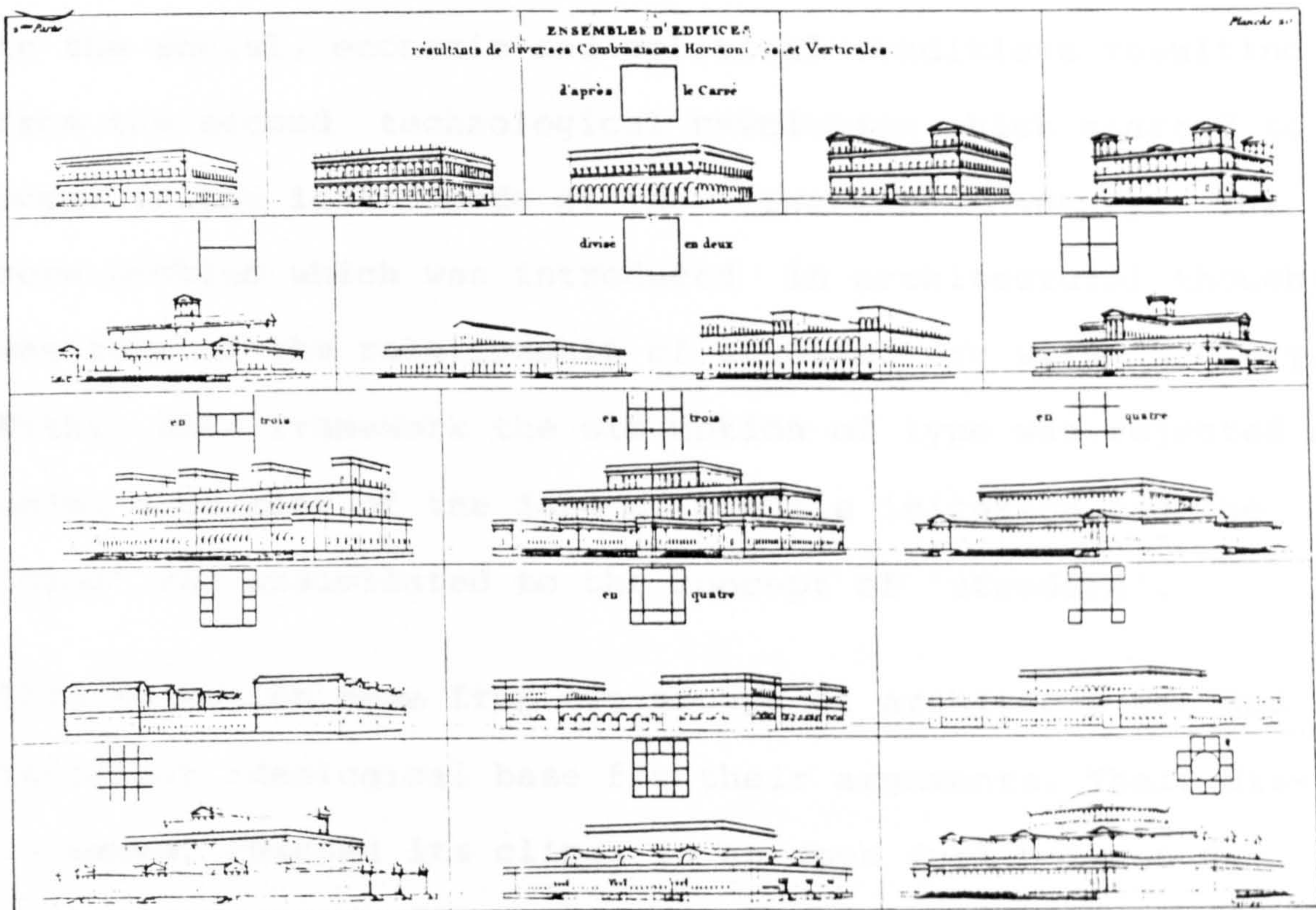
*"Or, si la cabane n'est point un objet naturel, si le corps humain n'a pu servir de modèle à l'architecture; si, dans la supposition même du contraire, les ordres ne sont point une imitation de l'un et de l'autre, il faut nécessairement en conclure que des ordres ne forment point l'essence de l'architecture; que le plaisir que l'on attend de leur emploi et de la décoration qui en résulte est nul; qu'enfin, cette décoration elle-même n'est qu'une chimère; et la dépense dans laquelle elle entraîne, une folie"*³³. [if the hut is not at all a natural object; if the human body had not served as a model to architecture; even if the opposite is assumed, the orders are neither an imitation of the one nor the other; it is necessary to conclude that these orders do not constitute all the essence of architecture; that the expected pleasure of their use and the resulting decoration is nil; that finally, this decoration is nothing but a chimera and the expenditure involved a folly] .

His ideas about the purpose of architecture were based more on the social usefulness of architecture and less on the notion of architecture as an artistic individual creation. Concerning the architect's task, he believed that this was to combine horizontally and vertically the elements of buildings (columns, walls, pilasters, doors, openings, roofs) and to create more complex entities, the principal parts of buildings (porches, halls, staircases, rooms, courtyards) which finally through the composition would be assembled in buildings. Durand described, following the analysis of his

method, various building classes and presented also many projects. Obviously influenced by biologists he did not use the term type but genre; this made him more consistent with the method he followed to describe the buildings; it was closer to the notion of classification than to typology.

Durand's approach was based on a classificatory concept of type. In the first place he classified buildings by their function and made groups such as hospitals, houses, schools etc. Secondly, he arranged the buildings within each group on the basis of a few criteria related exclusively to the compositional geometric principles of the plans, namely the axis and grid. The principles of composition were described either verbally or with abstract diagrams (fig. 198). His classificatory approach is underlined by the way he has analysed the facades and the sections of the buildings. He has fragmented them into their structural units (columns, walls, porches etc) and in general their role was static as the taxonomic criteria for his groupings derived from the plans. His taxonomies reflect his ideas about the analytic process that should be followed by the architects during design, and therefore they exclude any holistic approach that could lead to the identification of types.

Durand's ideas influenced the way architectural handbooks and manuals during the nineteenth century presented their material. His views and the classificatory notion of type seem also to have an influence on the recent work of Rob Krier which is analysed later in the section. With the work of Durand, Quatremère's notion of type and its distinction



from model was untouched. It reappeared in the early 1960's with the writings of the Italian theorist C.G.Argan. In the meantime, another idea of type was introduced in architectural thought with the modern movement during the second decade of the century.

Type and standardization

The beginning of the twentieth century witnessed rapid changes in the social, economic and political conditions resulting from the second technological revolution which started to occur in the last decade of the nineteenth century. The core problem which was introduced in architectural thought was that of the relationship of architecture with industry. Within this framework the old notion of type was rejected as being a carrier of the idea of sterile imitation and the 'type' was assimilated to the concept of 'standard'.

This rejection came from two groups of architects who had a different ideological base for their arguments. Their disagreement reached its climax in an open duel between H. Muthesius and Henry Van de Velde in the Werkbund assembly, held in Cologne in 1914. The main issue was standardization versus individualism. Muthesius used the word *Typisierung* instead of the word *Standardisierung* to denote the collective artistic effort towards the design of certain form types.³⁵ According to him this should be the task of architecture; and the reasons behind his choice were two-fold. The first was inherent in the nature of architecture. Muthesius claimed "architecture ... is striving towards standardization and only through standardization can it recover the universal significance which was a characteristic of architecture in

times of harmonious culture"³⁶. The second was extrinsic to the nature of architecture and stemmed from the national need for close cooperation between architects, merchants and industrialists to produce products of a high standard appropriate to the new needs of world markets.

Henry van de Velde and his supporters deplored Muthesius' views on the basis that they would finally lead to the subordination of architects to industrialists and also to the production of a mediocre eclecticism. They rejected completely the idea of any imposition on the architect and proclaimed the essential freedom of his creative work. Van de Velde argued that the architect " will never subordinate himself to a discipline that imposes upon him a type, a canon. Instinctively he distrusts everything that might sterilize his actions"³⁷.

The differing views of van de Velde and Muthesius, which can be summarized as an opposition of artistic freedom to a norm, and of the individual to the typical, found many advocates among architects (P.Behrens, R.Riemerschmid, W.Riezler backed Muthesius and A.Endell, K.E.Osthaus, B.Taut and R. Breuer supported van de Velde)³⁸. Both groups rejected the old notion of type. Even Muthesius and his supporters deprived the old concept of type of its philosophical features and its connotation of imitation and put forward another idea of type as a material, practical object, namely the future task of designers.

Le Corbusier like Muthesius proclaimed that the new spirit of the epoch and the new socioeconomic needs led to the necessity of mass production. Liners, airplanes and auto-

mobiles were examples of the realization of this pressing need for standardization. In this manner architecture should tend towards mass production houses or as he called them house-machines³⁹. The idea of a standard constructional unit - the house type - that would satisfy the urgent need for rapid rehousing after the First World War was the reason behind the design of Le Corbusier's Dom-Ino house (fig. 199). With this project he aimed to develop a structural frame, inexpensive, simple, flexible in use, that could function as a model to be repeated (fig. 200) and that could finally give birth to various solutions that might have no apparent resemblance. Thus, the house type and generally his idea about mass-production houses, i.e. the 'House Tools', denoted more the notion of model than the notion of type, and expressed the modernist conception of standard which was the inevitable result of linking the forms of architectural artefacts with the demands of mechanized industry.

Analytical and generative typology

The failure of the Modern Movement to explain and solve the increasing problems of the modern city and its architecture, becomes the object of criticism of the neorationalist movement⁴², and the starting point from which they develop their theory in the sixties. They propose another use of the concept of type within a framework of new ideas about the role of history and architecture for the understanding of the formal and structural continuity of the traditional city.

Giulio Carlo Argan⁴³, one of the early theorists of the

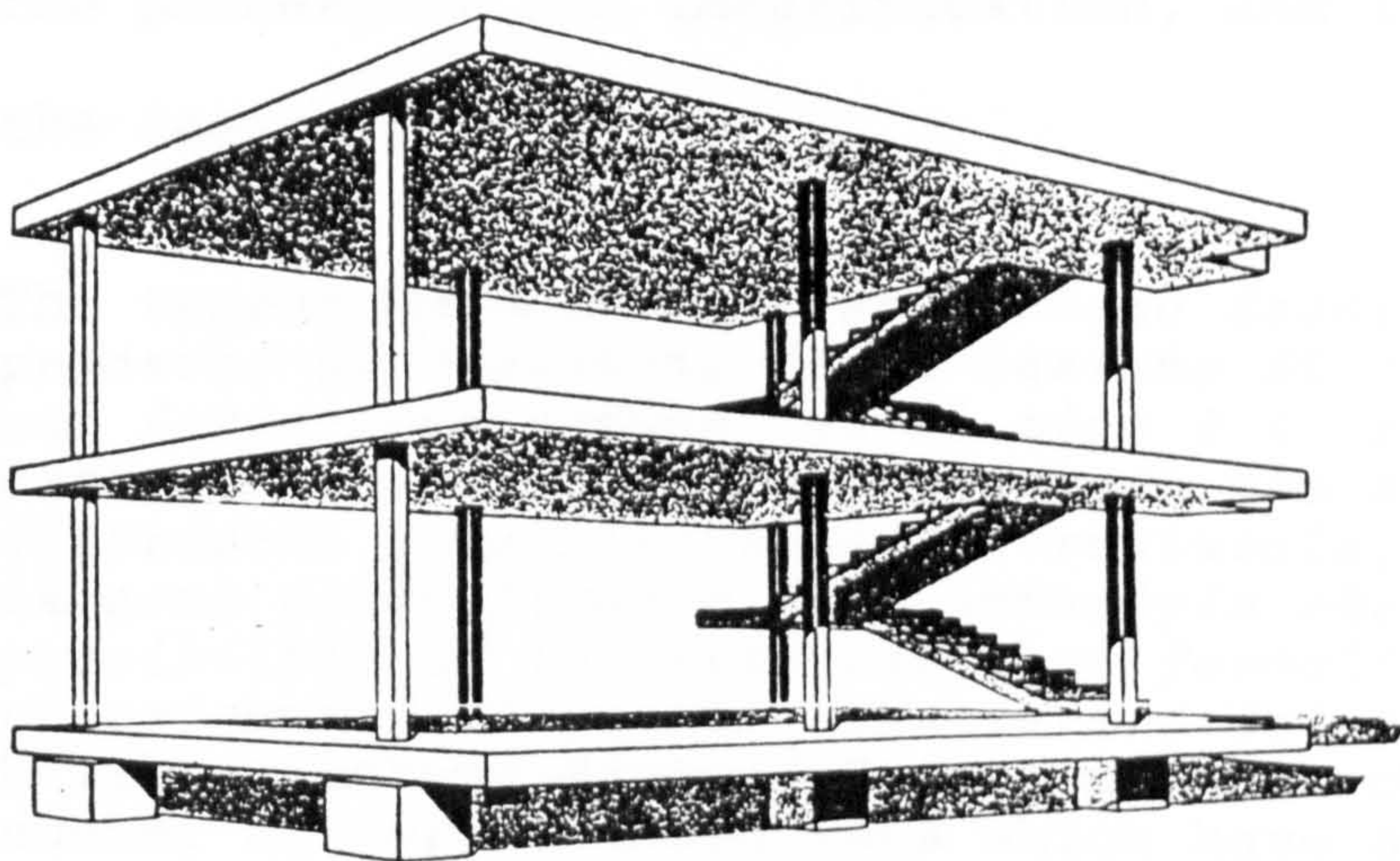


Fig. 199 ⁴⁰

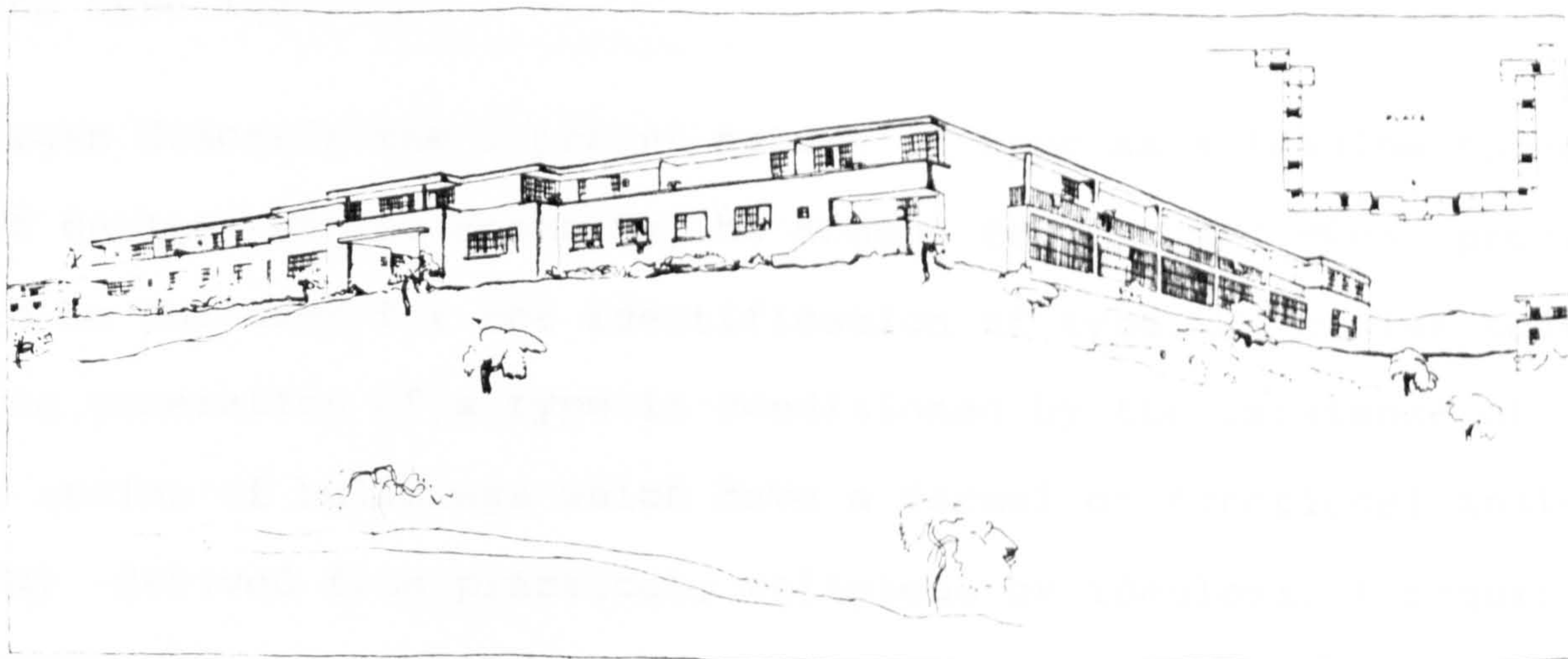


Fig. 200. A synthesis of many Dom-Ino houses ⁴¹

movement proclaims an idea of type close to that of Quatremère's, but free from his neoplatonic overtones. He proceeds a step further on from Quatremère's vague ideas and develops a comprehensive view for the concept of type, the process of its identification, and its involvement in the design process.

The type is for Argan "come uno schema dedotto attraverso un processo di riduzione di un insieme di varianti formali a una forma-base comune. Se il tipo è il risultato di questo processo regressivo, la forma-base che si trova non può interdersi come mero telaio strutturale, ma come struttura interna della forma o come principio che implica in sé la possibilità di infinite varianti formali e, perfino, della ulteriore modificazione strutturale del tipo stesso"⁴⁴ ["like a schema derived from a process of reduction of a number of formal variations which have a common form-base. If the type is the result of such a regressive process, the form-base that we find, cannot be thought of as a structural frame, but as an inner structure of form or like a principle that implies in itself the possibility of infinite formal variations and even of further structural modifications of the type itself"].

Argan discards the *a priori* nature of type as a leading force of design; on the contrary, he argues for an *a posteriori* process to be followed for the identification of type. He claims that the generation of a type is conditioned by the existence of a series of buildings which have a formal or functional analogy derived from practical, religious or ideological requirements. The type emerges through a process of comparison and overlapping of a number of examples whose particular characteristics are eliminated and whose common elements are conserved.

The comprehensiveness of Argan's idea of type is disclosed through his argument that typology is not classification, but a process carried out with a precise aesthetic aim which

demonstrates two fundamental features. Firstly, typological series are not related to the practical requirements (function) of buildings, but mainly to their configurations. Secondly, typologies are determined according to three main categories: the configuration of spaces, the system of construction and the decorative elements. Although Argan considers buildings as whole entities by attributing the type to all of their constituent elements, he is unable to escape from the segmentation of building into the two-dimensional design categories. the plan, the section and the elevation.

Aldo Rossi, the main representative of the neorationalists, is influenced by Quatremère and G.C.Argan, yet he has emptied the notion of type of its holistic properties. He has introduced his idea of type in his theory of urban artefacts in 'The Architecture of the City'⁴⁵ first published in Italy in 1966. In this he argues that the only comprehensive way to describe and explain the structure of a city is through its architecture. His method stems from the consideration that the city can be identified as an artefact and its constituent elements are the individual buildings and dwelling areas⁴⁶. He considers the buildings as moments and parts, unfolding through time and place, of the city. For Rossi as for Durand the walls, the columns etc. are the elements which constitute building and buildings are the elements which compose cities. From this basis he develops the characteristic concern of his theory which is the relationship between the typology of buildings and the city.

Typology for Rossi is an instrument of the analysis of the

city, of the recovery of the collective memory of the people and also a vigorous force in the design process. Type is a principle which is constant, permanent and complex and which exists beneath the concrete form and constitutes the essence of it. This principle can be found in all architectural artefacts and it possesses powerful links with society, since it derives from culture. Rossi, concluding the section of his treatise which refers to 'Typological Questions', writes that, "we can say that type is the very idea of architecture, that which is closest to its essence. In spite of changes, it has always imposed itself on the 'feelings and reason' as the principle of architecture and of the city"⁴⁷.

Rossi is searching, as he writes in his 'Scientific Autobiography' , for the fixed laws of a timeless typology. Thus, his type, considered in this way, approximates the notion of archetype. This concept allows Rossi to discover the relationship and continuity between the actual form and type, and consequently to understand the formation of the city. Furthermore, the notion of type is used not only for describing the known, but also for producing the future. Thus, typology becomes for Rossi the 'apparatus' in design.

Regarding the use of typology in his design⁴⁸ one might justifiably claim that there is a distinction between his theory and his practice. The formal choices he makes in his designs are rooted in his past personal images and memories. They derive from experiences of things in life and they appear in his design either as a whole or fragmented. As he writes: "likewise in my projects, repetition, collage, the displacement of an element from one design to another, always places me before another potential project which I would like to do, but which is also a memory of some other thing"⁴⁹.

Although Rossi's types derive from the Italian culture and environment in which he has grown up they still hold a personal character which may be difficult to read. Furthermore, the way he incorporates types in his projects produces an atmosphere of a dream, an alienation from reality where past and present are fused together inseparably. He evokes memories and images of de Chirico's paintings (fig. 201) and therefore his architecture becomes a kind of game between the rational and poetic⁵¹, between the personal and collective. His types, embodied in this way, are not always recognized by others. So, his desire to recover the collective memory of the people and through typology to create an atmosphere of permanence and individuality, becomes to some degree unattainable.

A somewhat similar approach to that of Aldo Rossi is illustrated in the work of Rob Krier.⁵² The basic premise of his theory is the alienation of city dwellers from their memories of urban space. This situation, he argues, has arisen as a consequence of the failure of the ideology of the Modern Movement and the changing relationships between those who take part in the production of the environment, (e.g. architects, clients, users, town planners, manufacturers, contractors, workers etc.), due to new social and economic conditions. According to Krier, the only way to revive the collective memory of the inhabitants of the city is to discover and reuse, either as a whole or fragmented, old meaningful types selected from the past of the city. He believes that the necessary prerequisite for the fulfilment

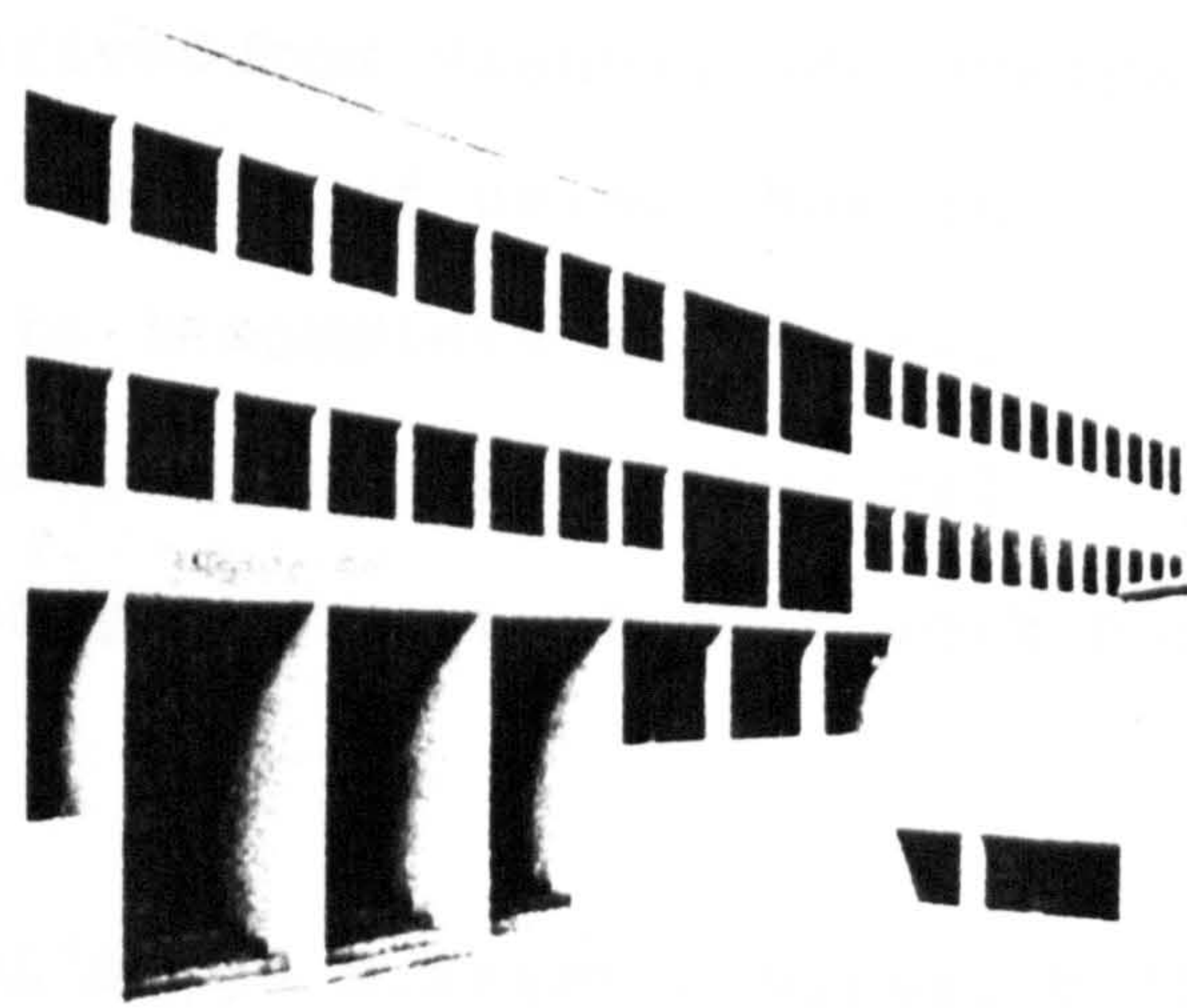
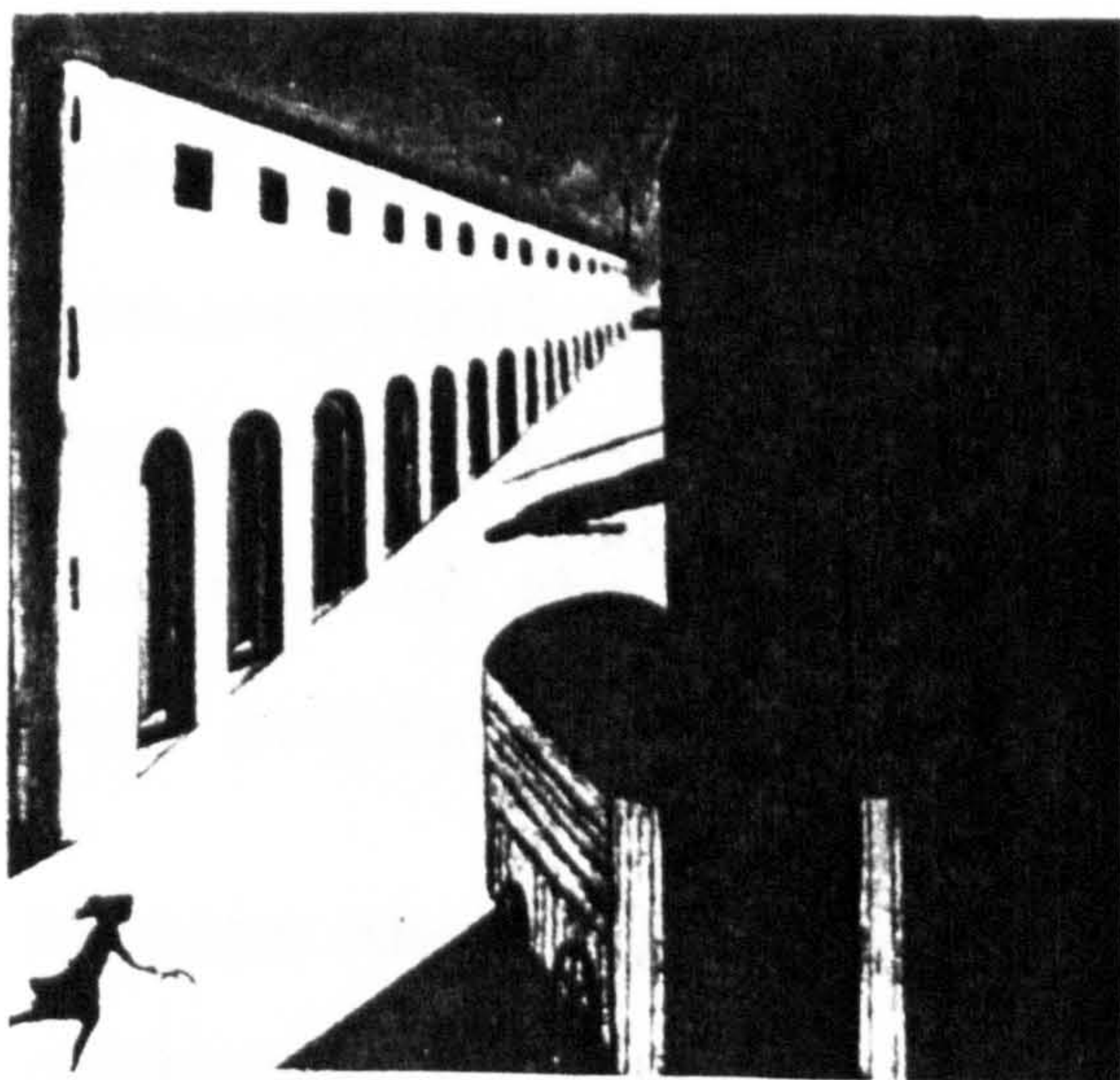
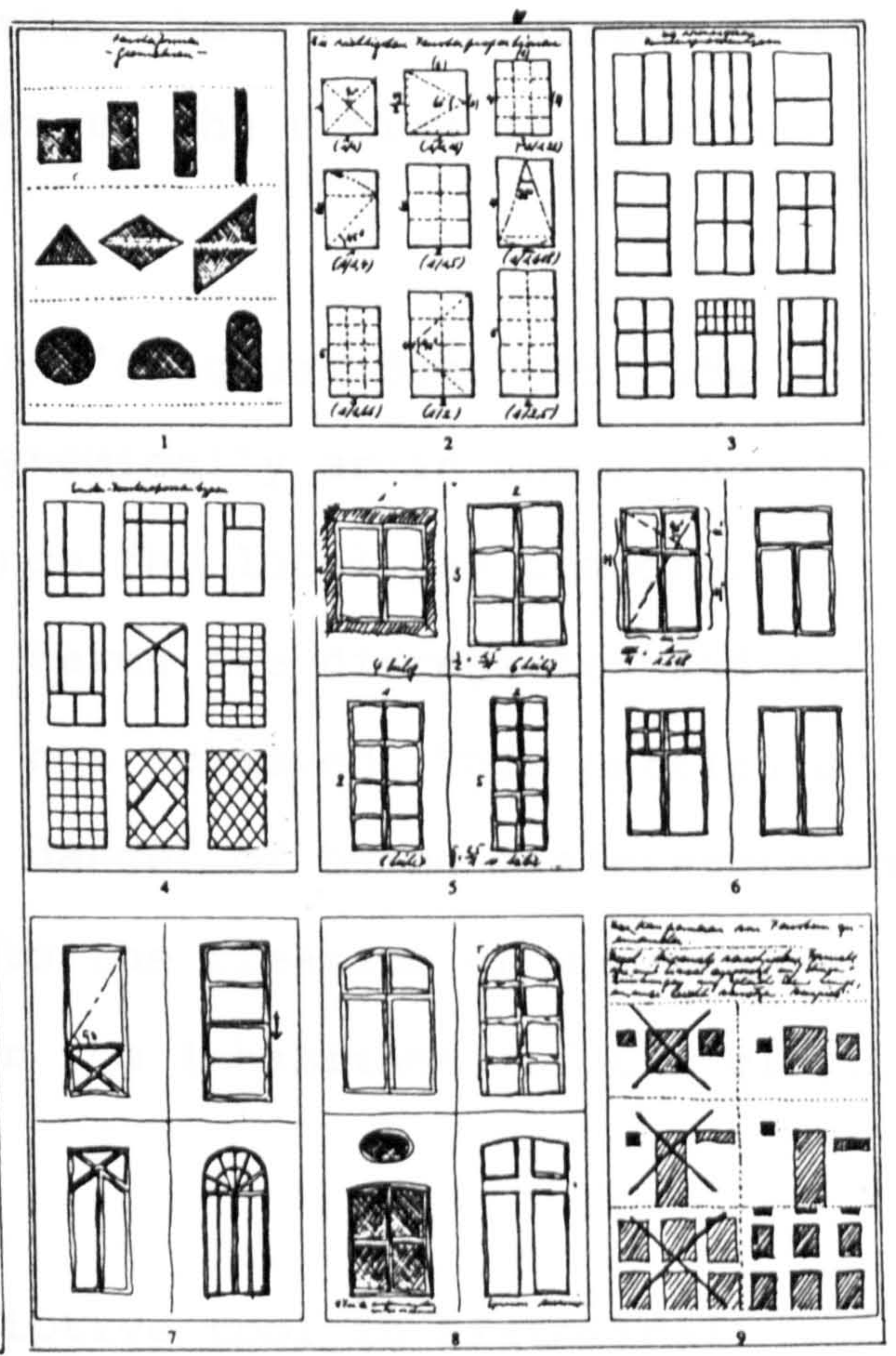
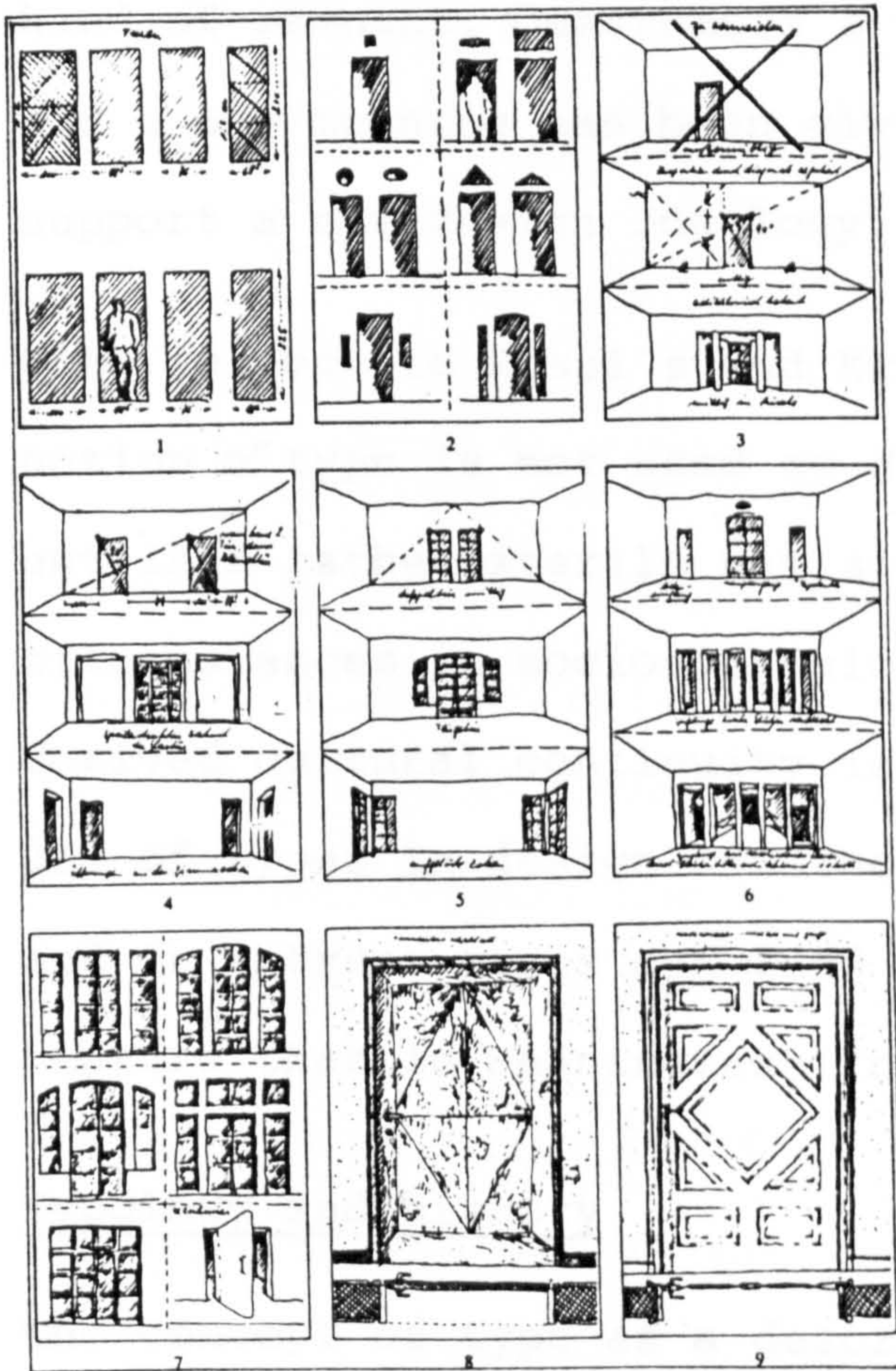


Fig. 201. A comparison between De Chirico's painting and Gallarate residential block in Milan designed by A. Rossi⁵⁰

of this task is to reveal, classify by type and interpret the basic ideas beneath the aesthetic characteristics of urban space.

However, his approach is formalistic when compared to the structuralism of Rossi. Krier's typologies are based on the geometrical and morphological characteristics of the buildings. In his recent work 'Architectural Composition'⁵³ he discloses a classificatory notion of type similar to that of Durand. He offers an extensive range of building elements e. g. doors (fig. 202), windows (fig. 203), roofs, staircases, attic, facades and so forth, derived from Vienna, and analyses their compositional rules with the aim of using them in architectural synthesis. There is incomplete information about the way he intends to incorporate the typological elements in the design, since only one part of this work has been published so far.

Despite the differences of Rossi's and R.Krier's views, both consider architecture in relation to the urban context from which it derives its meaning. They are concerned with the notion of type not only as a descriptive tool, but mainly as an instrument in design. Their types do not have holistic properties, but are fragments, vague principles from the past, and are reduced either to a general idea - such as the idea of the corridor which constitutes the basic typological allusion in the Gallarate apartments of Rossi, or the idea of the lighthouse which is the type in the design of his scientific theatre - or to a formal element - such as the patterns of windows, doors, staircases, proportions and



rhythm of the facades of old buildings in R.Krier's design exercises.

Thus, their types, considered either as principles or as formal features, are extracted from the past, are invariable and are kinds of historical survivals that can be juxtaposed and assembled in various combinations. In this way their idea of type loses its holistic character and becomes a kind of remnant. Quatremère's views have been misinterpreted and a new meaning has been given to the notion of type to support a new design ideology.

With respect to Rossi's and Krier's actual designing the notion of type is not used so dynamically as in their theories, but in a rather sterile way, since the local and temporal circumstances in socioeconomic terms are disregarded and the derived cultural continuity is not achieved. This particular use of types in design has the danger of being misinterpreted and in extreme cases can lead to the creation of an architecture that is meaningless for the inhabitants of the city.

Typology and history

The concept of type as a descriptive tool in historical analysis and as an animate force in design, appears in the work of three historians and critics: Gottfried Semper, George Kubler and Manfredo Tafuri.

In Gottfried Semper's writing and mainly in his work 'Der Stil'⁵⁶ the notion of type approximates Tafuri's and Rossi's as regards its characteristic of permanence, though Semper's point of departure has originated from a different set of ideas.

Apparently influenced by Cuvier's ideas and his system of classification of animals, Semper believed that artefacts in general are but concretizations of relatively few basic types on the basis that there is an analogical relationship between creatures in nature and creations in art. He wrote:

"in her infinite fullness, nature is nevertheless extremely economical in her theme, as is shown by a constant repetition in her basic forms. But these forms appear modified a thousandfold, diminished or extended in parts, fully developed in some parts and only hinted at the others, depending on the stipulations of the various creatures and creations and on different conditions. Just as nature has her own history of development within which the old themes constantly show through despite the various changes, so art is based on just a few standard forms and types which have been handed down from most ancient tradition. By the same token, these offer an infinite diversity as a result of their constant re-emergence and like those natural types have their own history. In this process nothing is purely arbitrary; everything is conditioned by circumstances and relationships"⁵⁷. Types are, as far as

Semper was concerned, few invariable forms which underlie the infinitely varied forms of artefacts in general including the concrete buildings. The origins of these types were two primary archetypes: the hearth (*Urherd*) and the cloth (*Urtuch*); the first marks of settlement and fabrication.

Semper's ideas were based on the misleading idea that the evolution of artefacts was analogous to the evolution of organisms in nature. Consequently, his belief was that the life of artefacts was an unbroken chain and artefacts themselves were manifold manifestations of certain archetypes. If this view is mirrored, at least to some extent, in the products of traditional craftsmen or builders, it is very difficult to apply it to or to justify the creation and origin of much of modern architectural and non-architectural productions. The application of Semper's view, in craftwork

and applied arts, exhibits a classificatory notion of type. However, his main contribution, though incomplete, is that with his systematization and classification he tried "... to break the organization of the history of art, as it had been set up by Winkelman in the first place, with its insistence on the priority of one people over another, with its hieratic attention to the individual artists. Semper's scheme was to concentrate on the unity of making, whether courtly or popular, and the growth of the arts and crafts from certain root processes, which were part of universal human experiences: settlement and partition"⁵⁸.

George Kubler, by comparison, avoids any connection with biological analogies and argues the difference between biological and historical time. He writes "Biological time consists of uninterrupted durations of statistically predictable lengths: each organism exists from birth to death upon an 'expected' life-span. Historical time, however, is intermittent and variable. Every action is more intermittent than it is continuous, and the intervals between actions are infinitely variable in duration and content"⁵⁹. Similarly to Semper he focuses on the broad domain of the experience of art - including architecture, sculpture, painting and cognate crafts - but unlike Semper he has not applied his theoretical views in a particular historical analysis.

His fundamental idea is the introduction of the concept of 'formal sequences', which approximates to the notion of a group of artefacts which are manifestations of the same type. He has arrived at this notion on the basis of a strong idea about the historians' commitment and on a rather superficial criticism of the conventional approaches of historians who employ the concept of style and biography. He argues, rather categorically, that "the notion of style has no more mesh than wrapping paper or storage boxes. Biography cuts and shreds a frozen historic substance ... The monograph upon a single work of art is like a shaped stone ready for position in a masonry wall, but that wall itself is built without purpose or plan"⁶⁰.

As an alternative he proposes the idea of the sequential classing of forms in order to bridge the gap between biography and history of styles. The notion of formal sequence derives from the view that works of art, apart from being historical events, are also solutions to a certain problem; they compose sequences whose mental form is the problem itself.

Linked solutions can be open series or closed and completed belonging to the past. With the concept of formal sequence the link of events is emphasized and the individual is perceived in terms of his situation.

The composition of the sequences is based on the linked succession of prime works with replications and the point of departure of a new sequence is the craftsman's or artist's will and his techniques. Furthermore, formal sequences limit the artist's actions who is not completely free to follow his own will. They determine his choices and consist a kind of 'invisible chain' with which he is bound, but "he is not aware of it as a chain, but only as *vis a tergo*, as the force of events behind him. The conditions imposed by these prior events require of him either that he follows obediently in the path of tradition or that he rebels against the tradition"⁶¹.

Kubler, despite his formalist approach and his rather summary way of presenting his arguments based more on artists than on architects raises a number of important issues: the fact that a group of artefacts with formal similarities are considered as linked solutions which correspond to certain problems, and constitute a formal sequence which can either be closed or open for further enrichment.

The occurrence of things involves a process of invention, repetition and discard. The continuous task of the historian is to search for the beginning and the end of the threads of happening and the duration of things.

Furthermore, this concise treatise⁶² touches on three fundamental issues: the inadequacy of biographical and narrative approaches, the relations among works of art, and the static nature of the notion of style as a means of classifying in historical analysis.

His ideas provide us, according to P. Steadman "with a descriptive account of historical sequence in the development of artefact types, and means for describing their morphological change"⁶³. However, Kubler did not apply his ideas in a concrete historical analysis and thus his views have the value of purely theoretical arguments.

The historian Manfredo Tafuri, an exponent of the neorationalist ideology, argues for the need to actualize history and to fuse elements from historical analysis with the design practice. To this end he proposes the use of typological criticism. Typological criticism is a kind of operative criticism which is the meeting point of history and planning, the tool to vitalize history. Historical analysis, according to Tafuri, should be more critical with an eye towards the future, and typological criticism "the instrument of the integration of criticism and the proposals"⁶⁴. Types are considered as formally invariant phenomena and as structural elements that "the contemporary city tends to see as immutable and undisputable values"⁶⁵ which in design should be upset, examined and reassembled in new forms. His arguments on the justification of the use of typology as an instrument

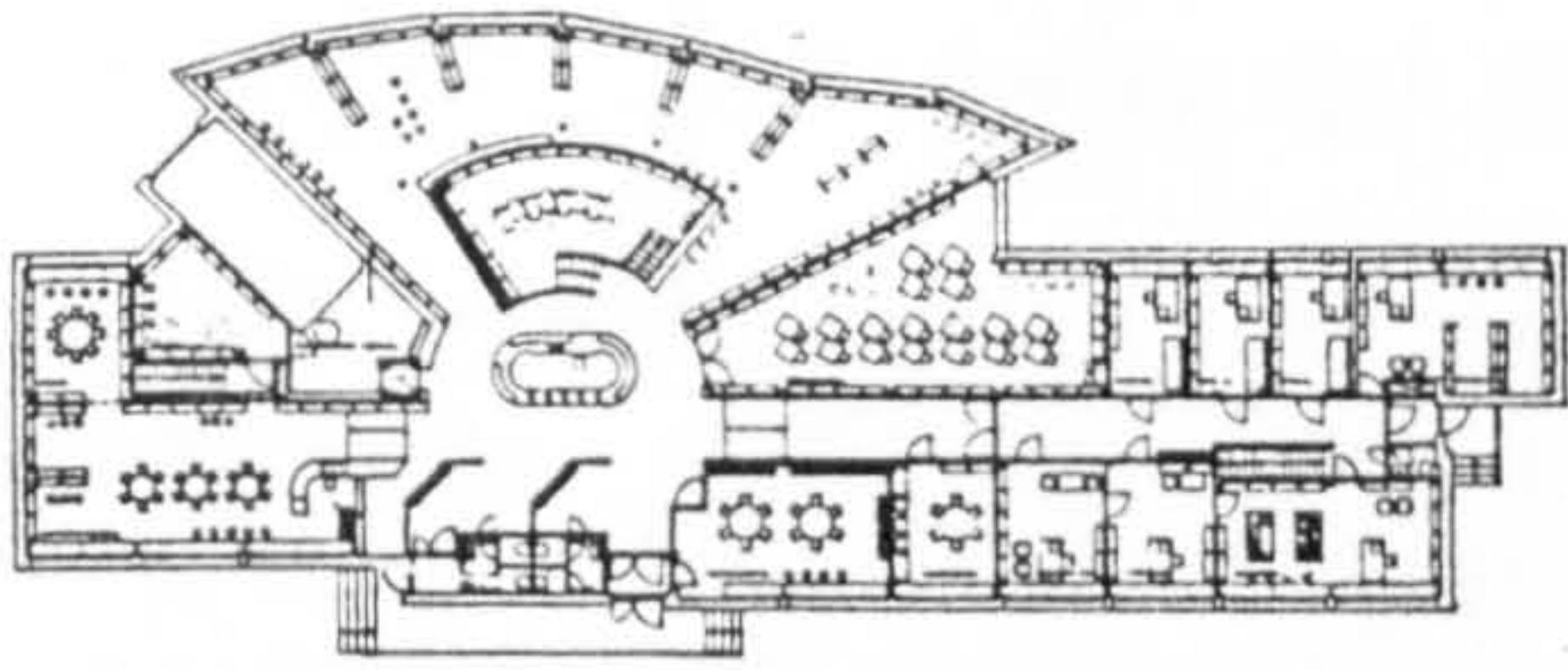
to integrate history and design are general and vague and his approach resembles that of Rossi'. Neither seeks to explain the origin of types, the relationship of different coexisting types or the animate force of the emergence of types. Above all they do not consider the type as a concept with holistic properties, but limit it to fragments of the spatial reality.

Typology and Design

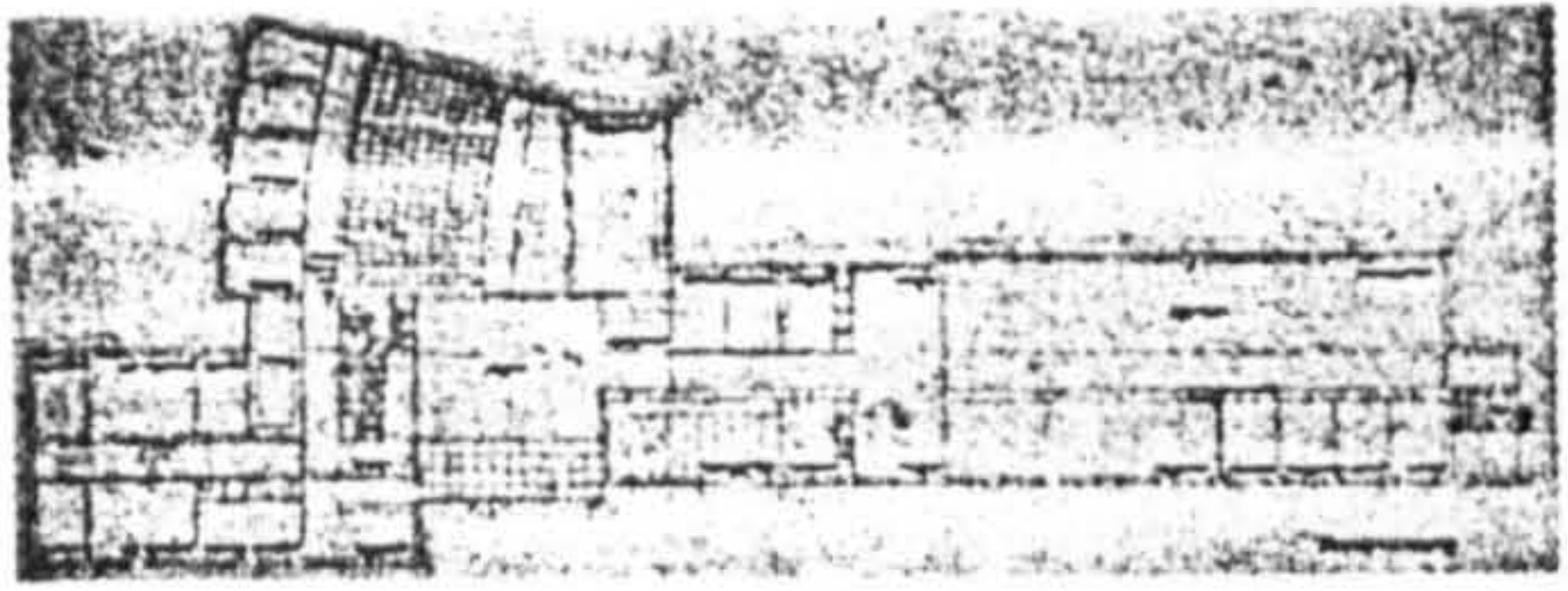
A different approach to typology has been taken by Alan Colquhoun who introduced the debate on types to British architectural circles in the late '60's. His approach has more the character of explanation than of prescription and is based on considerations of the mental processes architects experience while designing. In his article 'Typology and Design Method', he argues that typological procedures are inevitable in architectural design; the decisions that a designer takes are not merely the result of a strictly deterministic process leading from the analysis of needs to the final configuration of building, but also the result of his intention to attribute certain meanings to architectural forms, and in this way to communicate with others. There is a stage during design when the architect will find it necessary to follow intuitive procedures in order to achieve his intention to communicate meaning. This area of pure intuition is based, as Colquhoun writes repeating Maldonado's view, "on knowledge of past solutions to related problems and ... creation is a process of adapting forms derived either from past needs or from past aesthetic ideologies to the needs of the present"⁶⁶. Type, considered in this way, becomes a kind of communicatory tool, the link with the past, and the prerequisite for creating meaningful forms.

A similar idea regarding the involvement of form types in design is illustrated in a paper by B. Hillier, J. Musgrove and P. E. O'Sullivan⁶⁷ although this is centred upon a different point of view. They argue that designing takes place by focusing on conjecture-analysis procedures rather than on analysis-synthesis. An important part of their argument is that there is a phase in design when the architect pre-structures the problem - before this is further specified - in terms in which he can solve it. For this purpose, the architect uses elements which constitute his cognitive field: instrumental sets, past solution types, his informal codes and information concerning the problem he has to solve. In particular, his understanding of instrumental sets and solution types, which constitute what Hillier *et al* call 'internal variety reducers' of the design solution, act as "a kind of plan for finding a route through problem material that would otherwise appear undifferentiated and amorphous"⁶⁸. Thus, type can be considered as the inevitable imposition of the past on design, which, despite its inherent limitations, helps the designer to formulate his design problem.

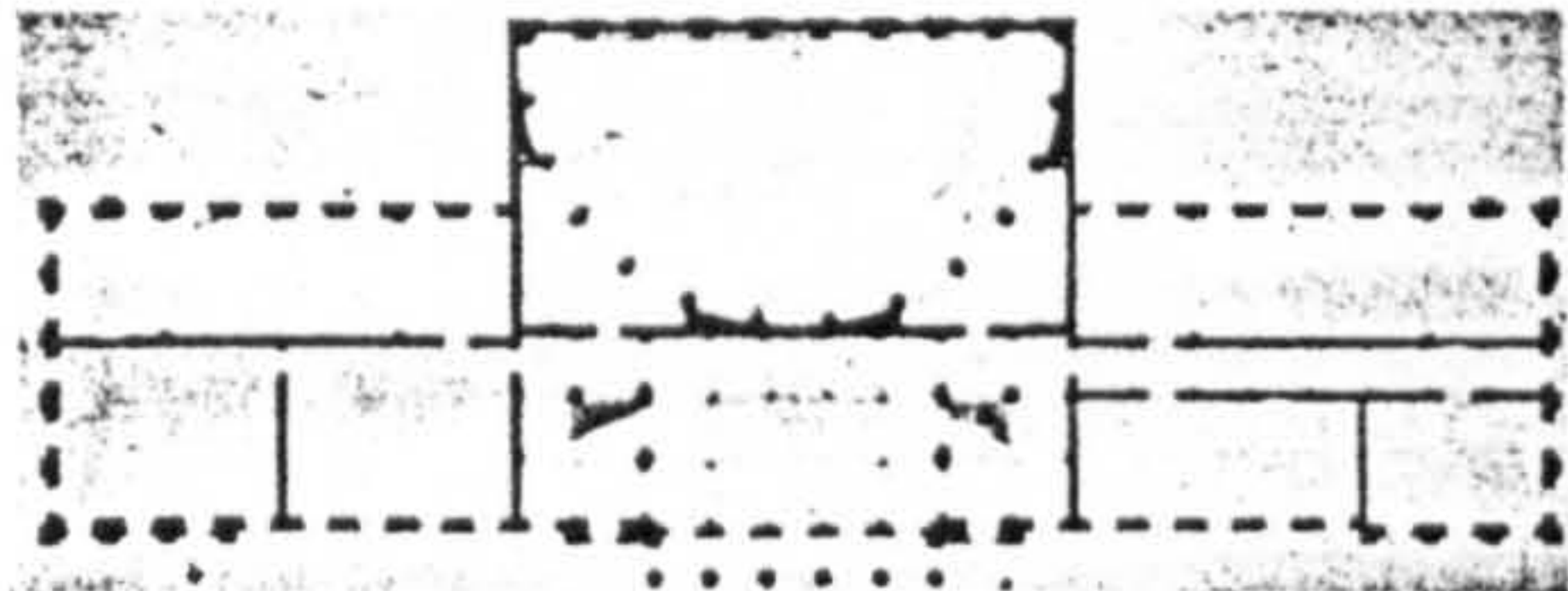
Typological borrowings from the past are also present in the conception of design of A. Aalto according to Demetri Porphyrios. In his book 'Sources of Modern Eclecticism'⁶⁹ he re-reads the work of A. Aalto and tries to reveal the typological allusions (fig. 204.205) of Aalto's buildings within a general attempt to describe the formal characteristics of Aalto's work, to display his design strategies and to explain their ideological basis.



1



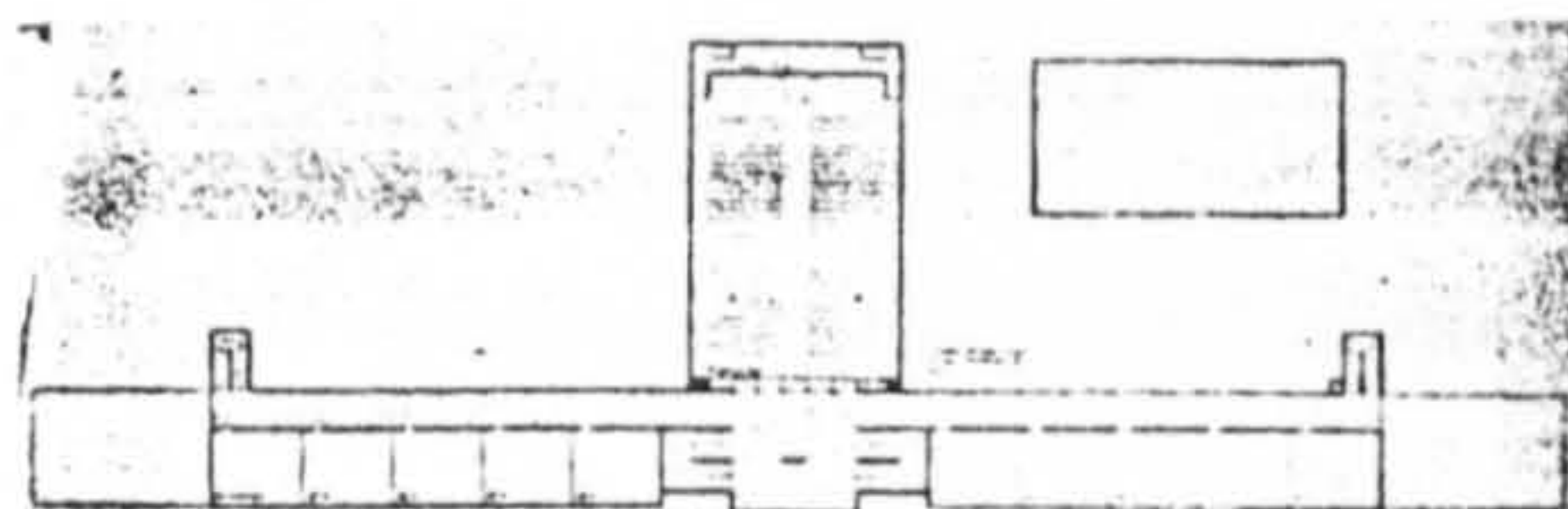
2



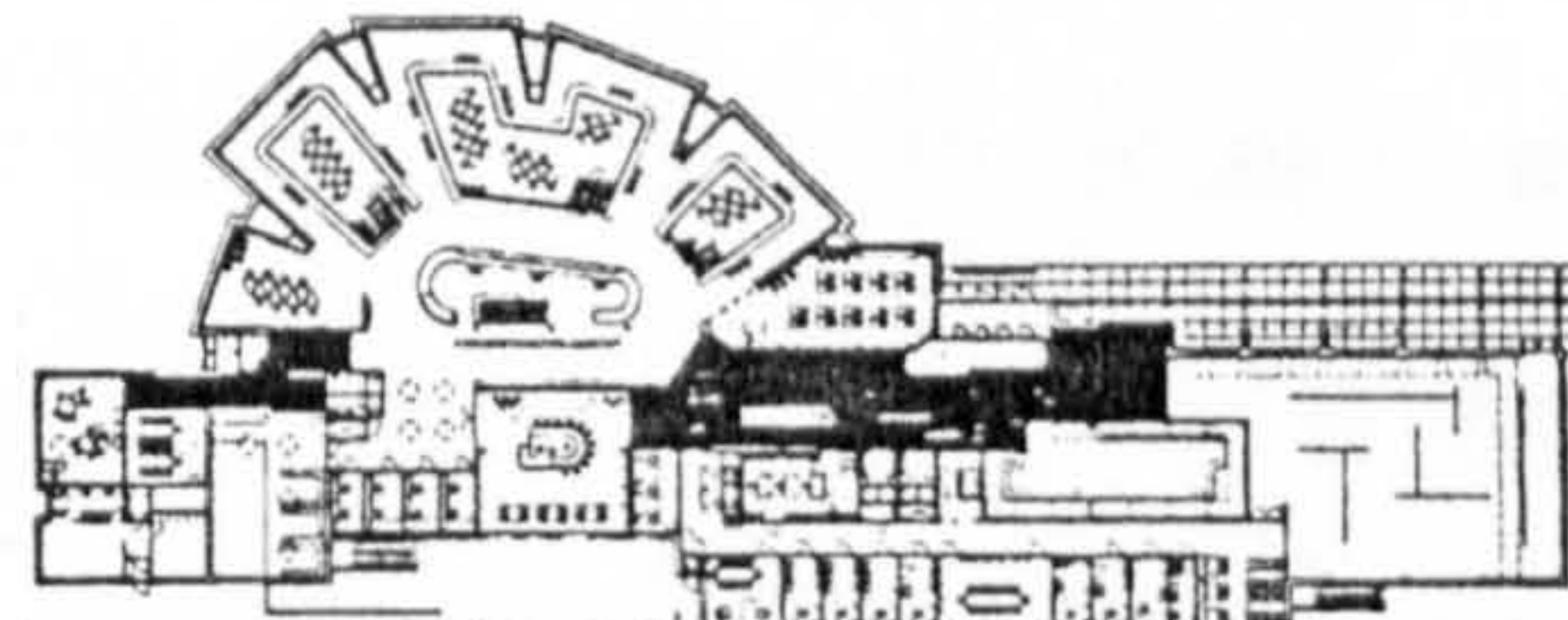
3



4



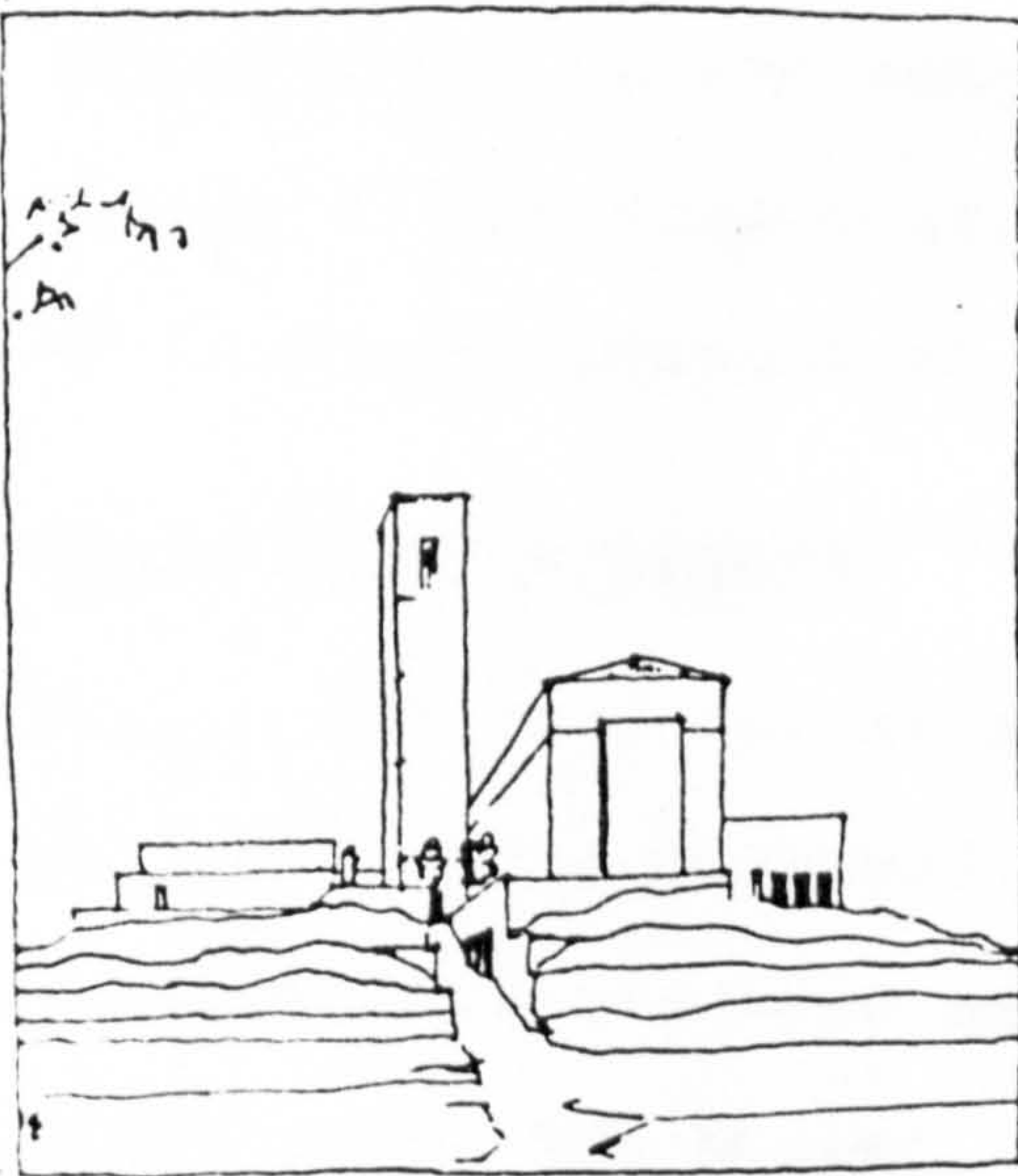
5



6

1. AALTO, Municipal Library, Seinäjoki 1959
2. BIRCH-LINDGREN and OTTESTEN, Karolinska Institute, competition entry 1937
3. ENGEL, Helsinki University 1828
4. AHRBOM and ZIMDAHL, Katarina Elementary School, competition entry 1928
5. 'PLUGGET', Katarina Elementary School, competition entry 1929
6. AALTO, Municipal Library Rovaniemi 1963

Fig. 204. Comparison of Aalto's plans with those of other architects. All seem to have the same compositional principles.⁷⁰



Töölö.



31

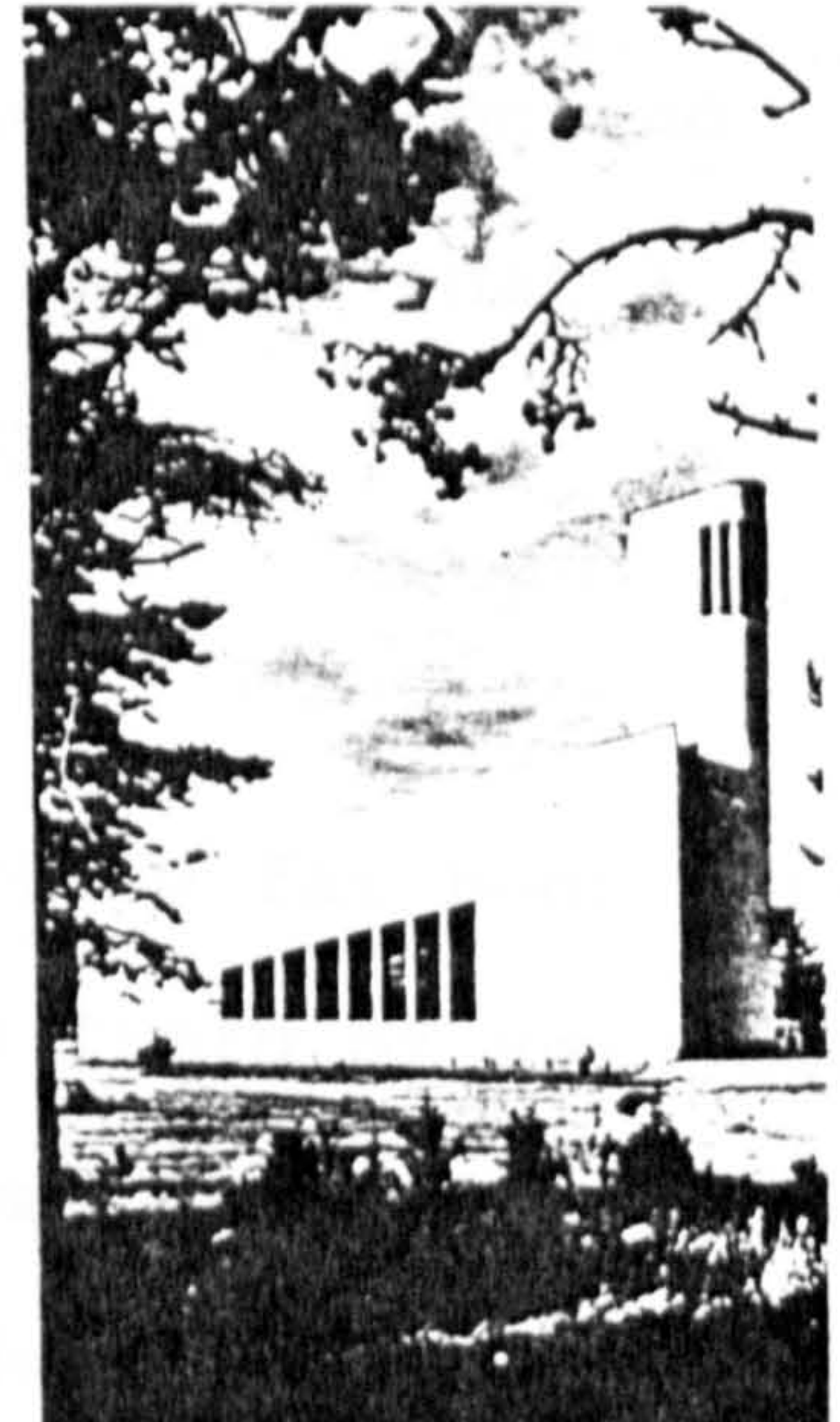


Fig. 205. Aalto's Töölö Church and few of its iconographic precedents⁷¹

Aalto's attitude to types, although he has not used the word explicitly, is clear in his statement that "Nothing old is ever reborn. But it never completely disappears either. And anything that has ever been always reemerges in a new form"⁷². His typological thinking is similar to Colquhoun's because it is based on the view that architectural forms become meaningful only when they are typologically codified⁷³. His architecture is deeply rooted in his own culture, and the sources of his typological borrowings have been the classical-vernacular tradition of Nordic architecture influenced by Romantic Classicism⁷⁴. Porphyrios' analysis seeks to reveal the hidden constructional rules - heterotopia, particularization, typology and metaphor - and the ideological links with the past in the architecture of Aalto. In this attempt, he does not reduce the typological analysis of buildings to the level of their plan and function. Porphyrios nevertheless fragments the buildings according to the design categories of plan, section and elevation, in a similar way to Argan. He distinguishes three categories of typologies: planimetric, sectional and iconographic which refer respectively to the composition of the plan, section and facade of the buildings. In this way, he implies that a building can pertain to three different types.

Typological analyses

Almost all typological analyses which have so far been carried out, have referred especially to the field of vernacular architecture and have been applied to a particular building class (i.e. the house). This is because dwellings are the dominant elements in the composition of the man-made environ-

ment; not only in quantitative terms, both in variety and in numbers, but also in qualitative ones. The house is certainly that which most immediately expresses the usages, customs, tasks and interrelations of people and even more the structure of the society.

Traditional anonymous houses are those that best reflect these features as they have originated from and been affected by them. Moreover, this architecture is deeply rooted in culture, and is transferred from generation to generation nearly unchanged. In this domain the use of types as instruments for description is obviously legitimate. In this case the notion of type expresses the anonymous builder's training, mental operations and his choices during design.

Unfortunately nearly all typological analyses concerning the building class 'house' lack any explicit basis in a concrete and coherent conception of types. As an exception the book 'Building Typology' of P. Tzonos might be mentioned. He presents his view of building typology as a descriptive instrument and proposes a procedure for the identification of the form types of each building class combined with their explanation according to the factors which influenced their creation. He prescribes three levels of analysis for the study of each building class. The first refers to the study of the social need which leads to the creation of building. The second is related to the way society satisfies the social need. The third - the level of the building - includes the identification of form types within the area of each building class⁷⁵. The analysis of the last level is to some degree

incomplete since the building is not regarded in a holistic way. The fact that his analysis is not all-inclusive is admitted in the introduction of his book where he states that it has both the advantages and disadvantages of a manual, which is for the use of the students; to a certain degree it must put into figures and shapes phenomena which by nature are complicated and often difficult to analyse.⁷⁶

In his recent book 'Typology of Housing'⁷⁷ he tries to apply the views presented in 'Building Typology', yet he does not avoid the fragmentation of buildings. The criteria for the typology derive from the articulation of spaces, the geometrical characteristics of the plans and the form of spatial volume. The constructional system and the formal language are completely eliminated. Consequently, his attempt displays a classificatory idea of type despite its aim to provide a comprehensive approach to typological analysis including the method for the identification of types and the base for their explanation.

Most typological analyses incline to a piecemeal approach. The reason is that the criteria employed for the identification of types are usually related to plans in terms of articulation of spaces within the building or of the relationship of inside-outside space. In cases where a complete description is intended the facades are fragmented into their constituent elements. R.W.Brunskill's approach in his 'Illustrated Handbook of Vernacular Architecture'⁷⁸ represents an example of a characteristic case where the facades of the buildings are described in terms of walling technique, raw materials, roof shape, windows, doorways etc.

Most importantly, the majority of the typological analyses considers types as groupings characterized by particular outstanding features of the buildings, which provide visual pigeonholes into which buildings are arranged⁷⁹. This particular dominant element gives the name to the type. This attitude towards typology can lead to false arrangements as in the case of F. Ragette who in his book 'Architecture in Lebanon' includes house A (fig. 206) in type 'The Gallery House' and house B (fig. 207) in type 'The Liwan House and Related Court Houses' despite their obvious similarities, and also house A and house C (fig. 208) in the same type 'The Gallery House', despite their differences. Apparently, this approach uses a classificatory conception of type and can lead to false conclusions concerning the interrelations of artefacts. This results in a partial description of buildings and it does not reveal their hidden common structural similarities as a 'true typological method'⁸⁰ should do.

4.3. THE CONCEPT OF TYPE IN VARIOUS DISCIPLINES

The notion of type in architecture as a methodological device for description has its origins in the taxonomic works of the biological sciences. Taxonomy in biology goes back to Aristotle's work, but has raised itself to play an essential part in the inductive schemes of scientific method particularly since Bacon⁸¹.

Descriptive methods in the biological sciences have had great influence not only in architecture, but also on taxonomic works in archaeology and other disciplines especially

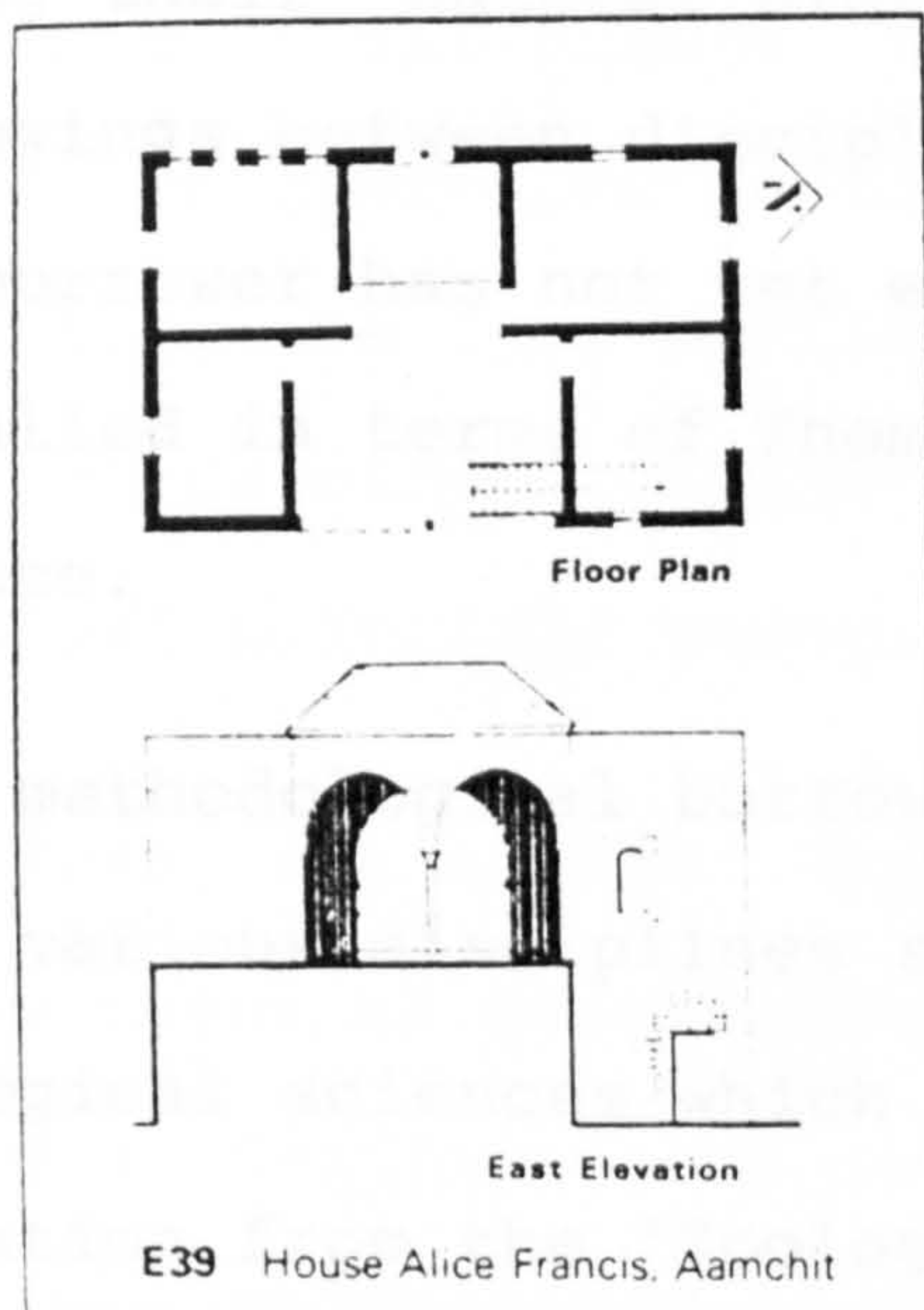


Fig. 206

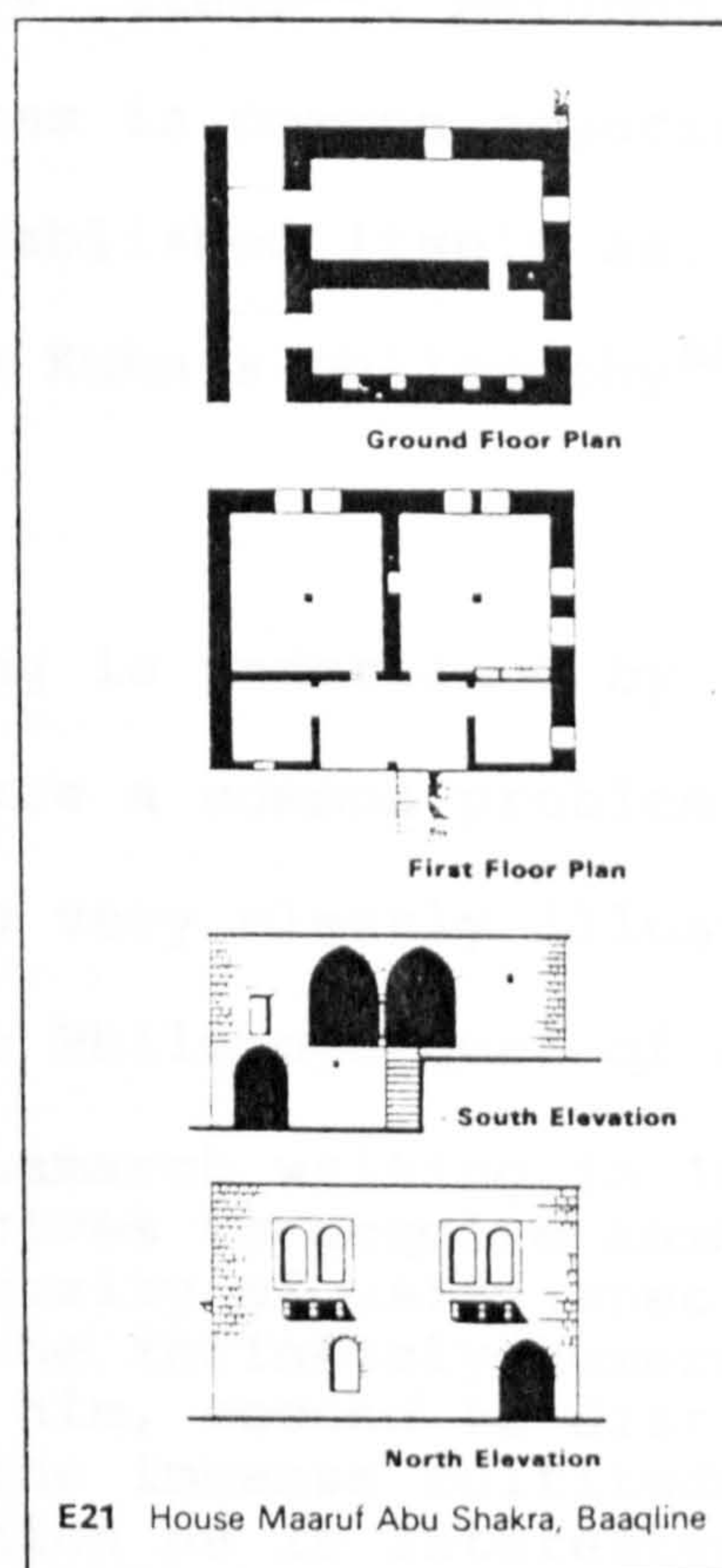


Fig. 207

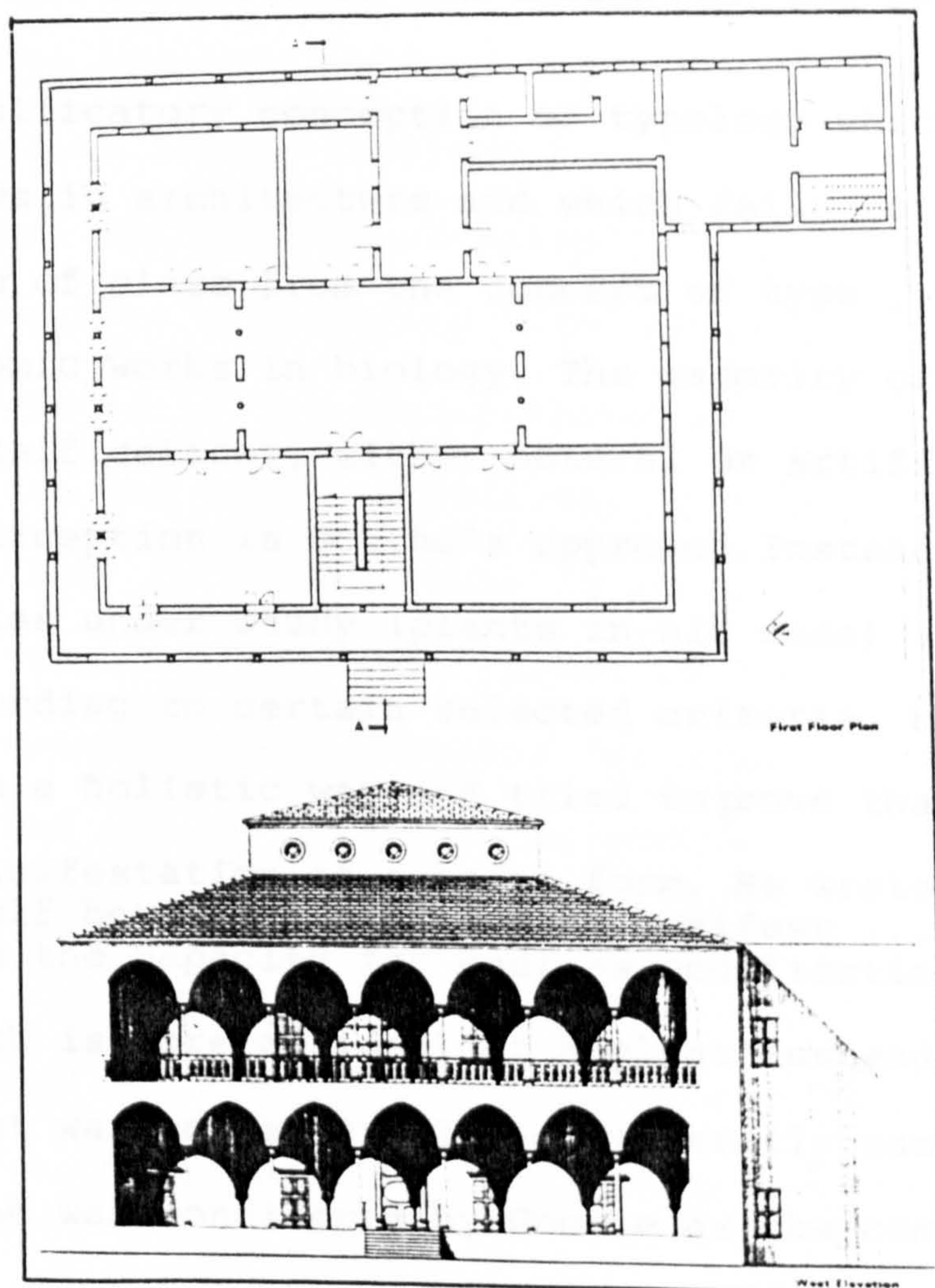


Fig. 208.

during their 'natural history' stage⁸². Methodological borrowings between disciplines is common especially when the borrower has not yet established itself as, what might be called in terms of Thomas Kuhn's philosophy⁸³, a normal science.

This methodological borrowing is underlined by the conception that various disciplines share a common problem with the biological sciences which is very clearly illustrated in a quotation from the 'Zoologie Philosophique' of Jean Baptiste

Pierre Antoine de Monet de Lamarch writing in 1809: "Throughout nature, whenever man strives to acquire knowledge he finds himself under the necessity of using special methods, first to bring order among the infinitely numerous and varied objects which he has before him, second to distinguish without danger or confusion, among the immense multitude of objects, either groups of those in which he is interested, or particular individuals among them, third to pass on to his fellows all that he has learnt, seen and thought on the subject"⁸⁴.

The classificatory conception of typology which underlines many views in architecture and which fails to distinguish the notion of class from the concept of type, has its roots in taxonomic works in biology. The majority of these are mere classifications, either natural or artificial⁸⁵. A notable exception is Goethe's approach. Instead of fragmenting the species under study (plants in his case) and classifying them according to certain selected criteria, he considered plants in a holistic way and tried to prove that every plant is the manifestation of a basic form. He wrote: "this basic form itself becomes more and more manifest ... and ... it possesses the capacity for endless modifications"⁸⁶. This form which is more an ideal of a plant instead of a concrete, real plant was coined *Urpflanze* (literally named archetypal plant) and was considered by Goethe as the common formative

principle of all plants. The notion of type in this way considered approximates the concept of the archetype which underlines the idea of Laugier's primitive hut. However, later he developed another view for the type to express the spiritual principle underlying a group of plant species.

Therefore, his revised type concept can be considered similar to the views of Quatremère de Quincy, G.Semper and G.C.Argan. Goethe's *Urpflanze* can neither be described adequately in words nor represented pictorially⁸⁷ - a limitation which seem to have been overcome in certain cases in architecture, as for instance in Viollet-le-Duc's iconographic description of city halls and cathedrals.

In archaeology, in contrast to biological sciences, the relationship between typology and classification, and the methodological issues involved have been debated at length. In addition, archaeological literature, in contrast to architectural, is preoccupied with a number of important aspects related to the significance and nature of types, their origin and their evolutionary pattern. The thorough investigation of these issues in archaeology is due to the fact that typology has been raised as the basic descriptive tool of archaeological analysis for several decades now. This derives from one of the broad objectives of archaeology which is the search for repeated similarities or regularities in relict artefacts from every area, period and environment.⁸⁸ However, the majority of researchers attribute different meanings to the concept of type and as D.Clarke argues

"... archaeologists are inconsistent in their usage of the term type and of the level of entity complexity to which they attach it"⁸⁹.

As regards the relationship between classification and typology, writers in the field of archaeology consider classification to be a generic term whereas typology is a more specific one. J.N.Hill and R.K.Evans stress this difference by writing that: "*class* is a generic term referring to any division of materials or events into groupings based on similarities and differences ... *type* has a more special meaning. It refers to the division of an assemblage of materials or events into groupings based on the conscious recognition of dimensions of formal variation possessed by these phenomena... Thus, a *type* is a specific class of phenomena which is characterized by a non-random cluster of attributes. Groupings based on a sorting of a single attribute dimensions are not types"⁹⁰.

Hill and Evans, who subscribe to a positivist view, propose as the distinctive criterion the number of the features of the artefacts selected by the analyst for his purpose. Thus, they fail to emphasize the most important dimension of the typological approach: its comprehensiveness which is opposed to the fragmentation inherent in classificatory procedures.

AlexKrieger, who takes a phenomenological and empiricist view, argues more comprehensively and eloquently the distinction between typology and classification in his article 'The Typological Concept'⁹¹. He examines the archaeological literature to find the attitudes of researchers towards the organization and description of their material. Finally, he summerizes them under four principal headings, namely the full description, the visually determined typologies, the classification systems and the true typological method. He focuses his analysis mainly upon the lasttwo,

because the time the article has been written classification methods enjoyed wide popularity among archaeologists.

He advocates the idea that the typological method is more comprehensive than the classificatory one since it helps the analyst to discover "the true historical meaning of the myriad works of man"⁹². He bases his arguments on the idea that the purpose of a taxonomist in archaeology is to group specimens into entities which have "demonstrable historical meaning in terms of behaviour patterns"⁹³. Classification as a method is rigid and unadaptable to different conditions. The divisions of artefacts are based mainly on morphological characteristics of the artefacts and take the form of pigeon-holes into which new objects are arranged and then listed. In this way, divisions aim at becoming universally applicable. The typological method expresses a different attitude towards archaeological analysis than that of classification; it is flexible, open and can be adapted to the material and to different historical and cultural contexts. This can be achieved by using as distinguishing criteria those that are of constant value; their choice is based not only on morphological characteristics of the artefacts, but also on the process of their production and mainly on the structural pattern in the maker's mind.

Thus, each type, argues A. Krieger, referring to Southwestern and Southeastern pottery types, "is defined by a specific and cohesive combination of features of paste, temper, texture, hardness, finish, vessel shape, technique and arrangement of decoration, use of appendages etc and ... includes what is believed to be individual variation within the technical pattern"⁹⁴ and furthermore is formed by a "combination of mechanical and aesthetic executions"⁹⁵.

A.Krieger and D.L.Clarke believe that there is a genetic lineage between artefacts which are manifestations of the same type. This view was clearly expressed by V.G.Childe when he wrote that "... archaeological phenomena can be grouped together as types just because results of private experience, of individual trial and error, have been communicated to other members of a society and adopted and replicated by them"⁹⁶.

The issue of the origin of types is very important, since it explains why a number of artefacts are repetitive manifestations of a type. In architecture it can hardly be argued that buildings which belong to the same type are products of designers who are influenced by one another. By accepting this view you accept the idea that designing is largely based on a process of imitation - either exact or metaphoric - where the designer is bound to act within certain limits imposed by preexisting types. This view is held mainly by such theorists as A.Colquhoun and R.Moneo.⁹⁷ The important issue they set up in a form of claims and hypotheses, is discussed in chapter 7 of this work on the basis of the results of the typological analysis.

D.L.Clarke explores a number of fundamental issues that the archaeologist repeatedly encounters. However important these topics are to any typological analysis they have remained untouched in architectural discourse with the exception of George Kubler who discusses part of them in general terms.

These topics are: the relationship between 'artefact usage' and 'artefact type', the categories of changes which occur in artefact type populations - either quantitative or qualitative -, the conditions of emergence and termination

of an artefact type, the connection between successive types and the number and quality of confluent types in a given period. At this point an attempt has been made to present these issues in the way Clarke does and set up for architecture claims open for further investigation.

In archaeology the problem of relation of 'artefact usage' with 'artefact type' is the same as the problem of relationship between 'building class' and 'form type'. In archaeology as Clarke points out "although it is clear that the concept of an artefact-type often coincides with a group of artefacts sharing a common purpose, this does not necessarily mean that usage pattern is both the sufficient and necessary feature for the definition of artefact-type. On the contrary, there are many different types of artefact which share a common usage and many single artefact-types which have multiple and diverse purposes in different sociocultural contexts... The linkage between artefact usage and artefact type is simply that artefacts intended for a given purpose will also necessarily possess a large number of functional attributes and constraints in common"⁹⁸.

It can be assumed that there is a similar situation in architecture concerning the casual relationship between building class and form type. It is possible for a type to pertain to more than one building class, though usually types are attributed to certain building classes. In spite of the fact that types are related to the overall configuration of buildings and not only to their functions (articulation and structure of inner spaces), yet a type is bound mainly to a particular class.

However, a type can occur in more than one building class if the classes involved are functionally analogous. This is due to the characteristic of the type which embraces the

principles referring to the building as a whole. Since one of the attributes that constitute a type is the reference to the articulation of inner spaces, which reflect relevant social relations, it is very rare to find the same type being manifested for instance, as a factory and as a hospital. It can however occur to factories, warehouses and even offices.

The problem of the kinds of change occurring within an artefact type system population is related to the general issue of the ontogeny of artefact types. D.L. Clarke distinguishes three categories of change: the quantitative change in the number of attributes within a developing type, the quantitative change of the number of artefacts which are manifestations of the same type (its output) during the successive phases of the development of type and finally the qualitative change of the artefact type system as a structured system.

Clarke's view is underlined by the organic analogue of birth, growth, maturity and death. An artefact type after its birth shows a quantitative growth in its output and a development towards the establishment of its general characteristics. A period of stability and maturity follows, and then its decline starts in terms of number of output and attributes, and it finally dies.

In a similar way D.N. Maronitis describes the emergence of a type and its re-manifestations in philology. He writes

that "... in philology the type, after its generation and trial acquires constant features which refer to its context, form and character, and allows its repetitive manifestations. Stability and repetition do not exclude variation with the presupposition that the basic traits remain unaltered"⁹⁹ .

The termination of a type, according to Clarke , occurs in three ways: transformation, displacement or cessation. Therefore, successive types are of two kinds: transform types and independent types. Transform types are descent related and are successive deriving from the same artefact type system. Independent types are not connected or derived from one another. Transform types usually have a direct cultural relationship, since their generators are of the same culture. Independent types may be endogenous products of the same cultural environment or may be imported from another culture. D.L. Clarke does not deeply analyse the relationship between transform types in terms of the kind and number of traits which are transferred from one type to the other.

In archaeology types are considered to derive mainly from culture. The quantitative and qualitative changes of types may be due to oscillation in fashions, but they reflect mainly changes in the sociocultural system and also changes in economic strategies. In a similar way Maronitis claims that "The number and the quality of types which dominate in a certain literary era, firstly reflect the social and cultural conditions of the respective period, and secondly, show the status and the dynamics (or enertia) of the literary techniques during the same period"¹⁰⁰ .

In architecture it is rather difficult to argue, without concrete empirical material, whether the changes occurring within a type and between successive types follow the same pattern as those of artefact types in archaeology. At a most general level both disciplines share a common aim: the study of human artefacts. Archaeology is concerned with the study of ancient artefacts, the remnants of ancient societies,

and architecture with human constructions, mainly buildings, which are going to be built or exist as whole entities and are still experienced by people. From this point of view the common aspect is more between archaeology and architectural history and less between archaeology and architecture in general. What makes one reluctant to accept that the types in archaeology have exactly the same characteristics with those in architecture is the significant difference between the number and nature of archaeological and architectural data. Archaeological data are many more than architectural ones; they are mainly remnants, so there is lack of complete information of their original form; the majority is not buildings; they are not experienced by people today and do not yield meanings. Finally, they have been produced through a process different from that of buildings at least of those designed in non-traditional societies.

However, Clarke's arguments for types in archaeology pose open claims for further investigation and are explored and discussed in chapter 7 in the light of the concrete results of the typological analysis of mills (chapter 5).

4.4. THE PRACTICAL APPLICATION OF TYPOLOGICAL METHOD IN HISTORICAL ANALYSIS

A diachronic typological analysis of building, that is an analysis dealing with types as they occur and change over a period of time, should focus on the common features of buildings that remain constant for a certain period (whether

short of long), comprehend the ideas which are behind the observable reality, and analyse the regularities or changes and interferences in the development of types.

A type is considered as an abstraction of spatial attributes common to a group of buildings resulting from their generative principles. Consequently, in historical analysis the notion of type establishes a kind of dialogue with the notion of style; it is neither synonymous nor opposed to style.

Style is a very vague term, though very commonly used, which according to the Encyclopaedia Britannica " ... like much of the vocabulary ... resists straightforward definition"¹⁰¹ .

The majority of theoretical surveys provide a wide range of definitions from general to more specific ones. It has to be taken into account that the majority of definitions of style has been given by theorists of art who are reluctant to use architectural examples to support their arguments although there are a few references to architecture.

The most general and all embracing definition is given by

Encyclopaedia Britannica: "the word (style) may point to little more than a mode or form of artistic production; or it can designate traits regarded simply as aids in the task of dating, grouping and attributing works of art; it can imply skill, grace ...; it refers to a mode, form, manner, tone, theme, subject or quality - or a combination of such - that is felt to be characteristic enough to evoke a person, a group, a class, a nation, a place, a period, or a civilization"¹⁰² .

James S. Ackerman takes a more concrete position. He writes

that in the study of the arts "... we must find certain characteristics which are more or less stable, in the sense that they appear in other products of the same artist(s),

era or locale, and flexible, in the sense that they change according to a definable pattern ... A distinguishable ensemble of such characteristics we call a style"¹⁰³ . In

his definition Ackerman avoids designating precisely the kind and nature of characteristics which are constant in a number of works of art.

Meyer Schapiro gives a broader definition which transcends the common use of the term on the basis of Wölfflinian

concepts. Schapiro claims that "by style is meant the constant form - and sometimes the constant elements, qualities and expression - in the art of an individual or a group ... is, above all, a system of forms with a quality and a meaningful expression through which the personality of the artist and the broad outlook of a group are visible"¹⁰⁴ . In his

critical survey of twentieth century speculation, Schapiro points to the fact that the notion of style is not arbitrary and despite its various uses by different writers it refers to three aspects of art: form elements or motives, form relationships and qualities. In a similar way Christian Norberg-Schulz considers style a "syntactic system which traditionally covers formal properties common to a collection of works"¹⁰⁵ .

Despite the fact that many shades of meaning seem to be attributed to the notion of style, there is a commonly accepted aspect: the connection of the concept of style with the form and formal motives rather than with abstract principles and relations. The type refers mainly to a deeper level than that of the formal expression, and furthermore it is not restricted to formal properties, but embraces those related to space and the material means of the realization of building. Type is a number of principles prior to and behind the form; they constitute it and reveal themselves through it. However, the identification of type is an *a posteriori* process

of the creation of buildings. Type emerges from the comparison and overlapping of buildings which usually belong to the same building class and are formally similar. Although the type is different from style, it interplays with it. A type may be concretized in different styles and different types may evolve on the same style.

The concept of type, as has been analysed in the first two sections of this chapter through its historical and contextual transformations, has a holistic property which distinguishes it from the notion of class. The comprehensiveness of the notion of type implies that a type is identified not by few outstanding characteristics of buildings, but by a process based on a systematic study of the whole. Thus, a procedure that should be avoided in using types is to isolate significant details, on the basis of certain criteria, and afterwards employ them to represent or refer to the whole. On the contrary, a combination of features is required which accounts for the entire building. These elements derive from the consideration that the building is concrete, has material substance and fulfills human, physical, psychological and social needs. A building is not purely a material thing which stands by itself and has spatial properties that can be described in formal and technical terms; it is like a living organism which has an active interaction with man, the man-made environment and the natural environment as well. Furthermore, it embodies and communicates meanings; it possesses a certain character and it is experienced in various ways by people. Thus, the type should not refer

only to spatial and geometrical characteristics of the building, but to the properties which determine its character. One is unable to describe these properties without the vague language of qualities. There are certain overall features related to the general atmosphere of the space which are specified better in qualitative terms like cool, warm, ascetic, etc.

The question that arises is how and by what criteria the material will be organized so as to lead to types. For this purpose, characteristics have to be identified which should integrate to define the building as a complete entity.

Thus, a group of buildings can be considered as manifestations of the same type when they have common properties which refer to the general components of the architectural totality; these are the articulation of spaces, the spatial volume, the formal structure and the means of the technical realization of buildings. The articulation of spaces is related to the abstract image of the ground plan, while the spatial volume refers to the building as a three-dimensional object and concerns the architectural image which is obtained as one walks through the whole building or around its exterior. The formal structure is related to the formal properties of the bounding surfaces of the building, and the means of technical realization of buildings to technology and materials.

The type is formed by a combination of features which refer to all the above general categories of components of the architectural totality. Furthermore, it is defined by another

characteristic as well; the dominant feature of all the features which are common to the type population. Finally, this dominant trait gives the name to the type.

In the next chapter, the general components are analysed in detail in terms of the particular traits of mill buildings.

CHAPTER 5

THE TYPOLOGY OF MILLS

INTRODUCTION

This chapter contains a typological investigation of the empirical data of the survey. It seeks to identify the types of the textile buildings in Greece and thus, to reveal the cluster of features and characteristics which are constant for a certain period and are common to a group of mills. Furthermore, it seeks to arrange the types on the basis of their geographical and temporal occurrence.

The analytic-synthetic process of this chapter is not intended to provide any explanation of the buildings: it rather offers an organized picture of them emphasizing those traits which have developed and remained constant throughout long periods. In other ways, it tries to achieve historical reconstruction on the basis of established types.

The first section (5.1) presents the procedure of the typological analysis based on both the theoretical conclusions of the previous chapter and the particular characteristics of textile factories. The second (5.2) includes the description of all types accompanied by a series of sketches drawn up from the buildings of the sample. In the final section (5.3) the identified types are compared in terms of their succession in time and space, and also in relation to the number and kind of traits which have been transmitted from one type to the other.

5.1. THE PROCEDURE FOR THE IDENTIFICATION OF THE TYPES OF MILLS

The first step before the identification of groups of mill buildings which share a range of common traits, is to analyse in detail the five general categories of descriptors on the basis on which the mills are decomposed and the types are made up.

The following table illustrates the five general categories and their descriptors.

GENERAL CATEGORY	DESCRIPTORS
0. The dominant feature	
1. The articulation of spaces	1.1.The spatial composition and the relationship between the functionally different spaces 1.2.The kind of the production process
2. The spatial volume	2.1.The shape and size of spatial volume 2.2.The form of the roof 2.3.The kind and distribution of openings and the inside-outside relationship 2.4.The way the building is related to the earth and sky
3. The formal structure	3.1.The composition of the facades 3.2.The means which give an expressive quality to form
4. The means of technical realization of building	4.1.The structural system 4.2.The building materials

Table 20

Descriptor 1.1 refers to the composition of the main spaces of mill buildings i.e. the area of production, administration, warehousing and workers' facilities. The structure of spaces

can be described verbally with adjectives such as simple, disorderly, irregular, accidental and so forth, and can be represented with abstract diagrams like those employed by J.N.C.Durand¹ and P.Frankl in the analysis of the ecclesiastical and secular buildings between the fifteenth and nineteenth centuries². The adjectives refer to the qualities of spatial composition in general, whereas the diagrams show the sequence of spaces and their geometrical or topological relations.

Descriptor 1.2 particularly concerns the production activity which is the main and dominant function of a factory. It refers to the general characteristics of the production process which are reflected in the choice of the spatial composition. The production process can be linear, extended to one line or parallel lines, distributed to many levels or different buildings, continuous or interrupted etc.

Descriptor 2.1 refers to the general geometrical features of the mills which are considered as abstract stereometric shells stripped of their characteristic motifs. For this purpose two sets of adjectives are used. The first (i.e. large, small, high, low, horizontal, vertical, rectangular and so forth) express geometrical properties and the second (i.e. regular, irregular, compact, heavy, light etc.) express qualitative ones.

Descriptors 2.2, 2.3 and 2.4 are interconnected and concern the way the spatial volume is related to its environment. According to C.Norberg-Schulz there are three primary kinds

of rising i.e. the building's relationship to the sky³. There are the vertically 'open' buildings, the 'closed' ones which are like individual bodies surmounted by a heavy roof and those delineated by a neutral horizontal line which emphasizes the lateral extension. He also distinguishes three ways of standing i.e. the building's relationship to the ground. A building may stand *in* the ground, *on* the ground or *over* the ground⁴. The kind and distribution of openings determine how 'open' the mills are to the environment and establish the inside-outside relationship, that is the way the viewer perceives the building as he walks around and through it.

When the mill has more than two spatial volumes built on the same site, another descriptor, which refers to the way the volumes are articulated and organized, has to be used.

Descriptor 3.1 concerns the composition of the facades which can be analysed in terms of formal elements (line, surface, volume) and their principles of articulation (axial composition, proportions, repetition, contrast, dominance, rhythm, absence of articulation etc.)

While the descriptor 3.1 refers to the vocabulary and syntax of the formal language, descriptor 3.2 concerns the manipulation of materials, colours, texture, light and use of characteristic motifs. These features give an expressive quality to the building because they are the primary factors of the effect produced by the complete building.

Finally, descriptors 4.1 and 4.2 are related to the technical

dimensions of buildings. The structural system can be of two kinds: load-bearing or skeleton frame. The building materials refer to the structural frame, the infill elements and the roof.

With these descriptors in mind, I have made an initial sorting of the buildings of the sample into groups which contrast strongly with one another and seem within themselves to be manifestations of the same cluster of attributes. The arrangement of buildings into groups have been based on two premises. The typological analysis usually leads not only to the identification of types but also to their various syntheses in the form of composite types. The buildings which are now a result of sequential expansions should be arranged as many times as the number of their additions.

The initial sorting into trial groups is empirical and some questionable buildings - i.e. buildings which do not share a common set of properties with any other-are set aside to be analysed in the second phase of the typological analysis. This first arrangement has produced five basic categories of groups of mills. The first two groups namely A and B (fig. 209) embrace those mills which are more readable as structures than the others.

Group A includes three clearly distinguished types. All mills which belong to one group share common principles which refer to all the constituent aspects of a type.

Group B includes three tentative types. The term 'tentative type' has been used to denote those groups of buildings

which have a large number of common features, yet not enough to define types. Tentative types have produced types and composite types during the second phase of sorting.

Group C is made up of mills which have been expanded

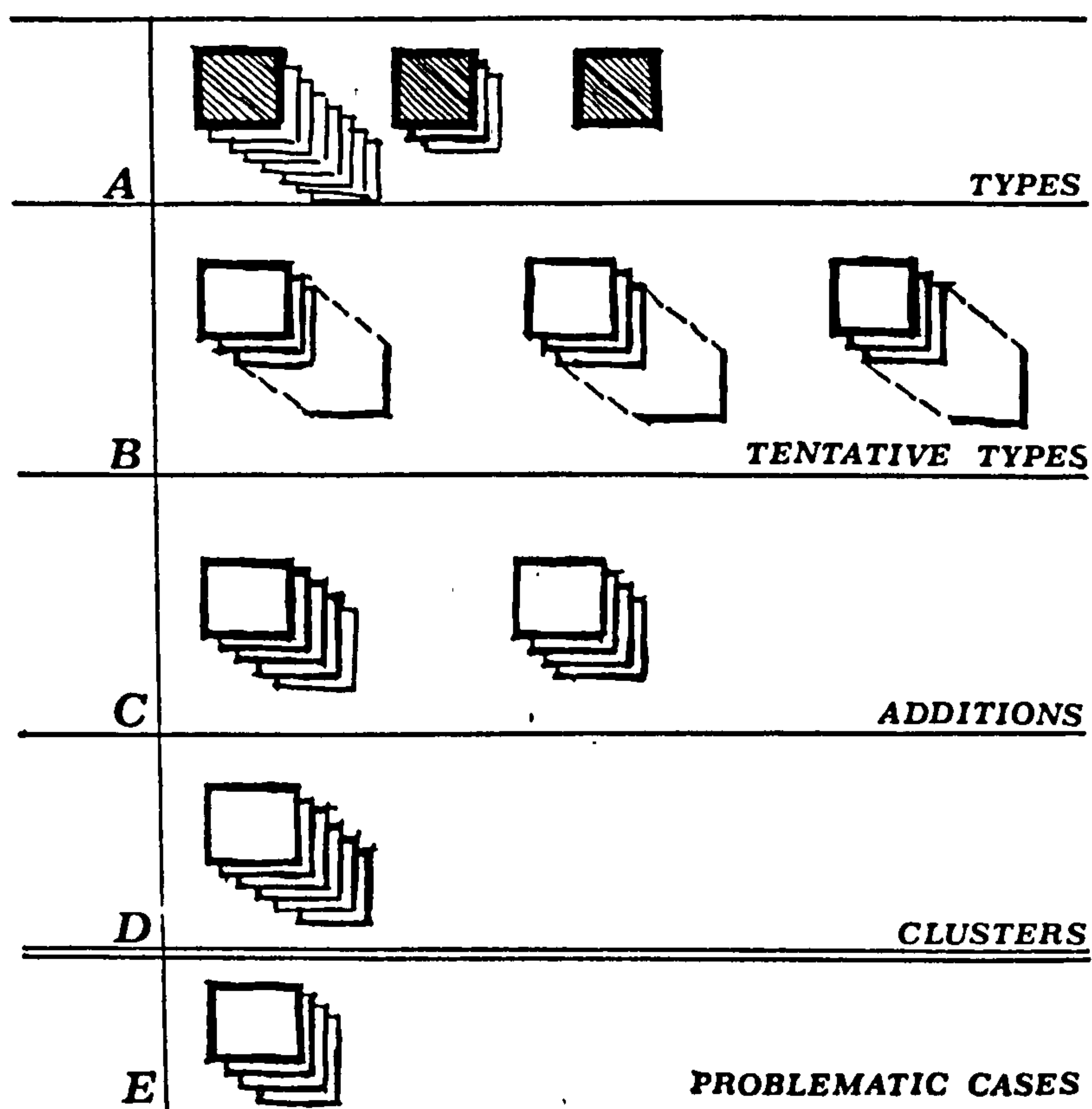


Fig. 209. Initial sorting

during their life. I have divided these mills into two categories. The first category includes those buildings the additions of which have a clearly distinguishable character different from the character of the previous expansions. Thus, these buildings look like a collage of parts and most probably are based on a synthesis of pure types. The second category of mills which belongs to the 'additions' is characterized by the complete consolidation of the new parts so that a homogenous identity has been achieved.

Group D represents all clusters of buildings, that is cases where the mill consists not only of one spatial volume but also of a cluster of buildings organized either topologically or geometrically on one site.

Finally, group E includes all questionable buildings which do not seem to belong to any of the other groups, at least during the initial sorting.

In the next step after the preliminary arrangements, groups B, C and D have been broken down according to their differences. This rather complicated process is illustrated in fig. 210 based on a hypothetical situation. I have considered that during the initial sorting a group of buildings have a number of common characteristics which can be represented with the set $S = (a_1, a_2, a_3 \dots a_k)$. It is important to note that the necessary and sufficient number of attributes to define a type is n , and k is a number quite close to that but smaller. Group A has been divided in three subgroups A_1 , A_2 and A_3 . The first group A_1 resulting from this

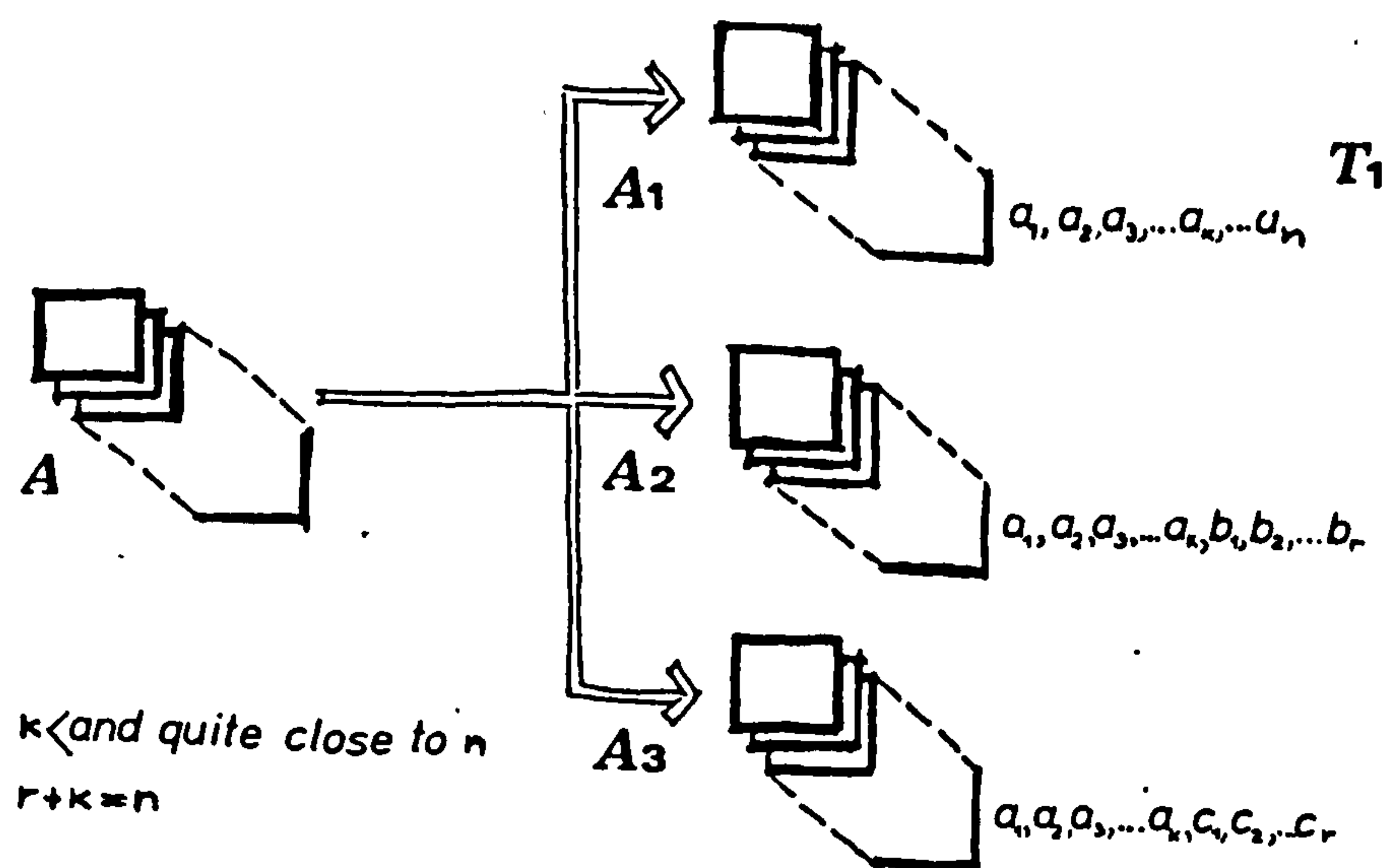


Fig. 210

procedure embraces mills which have a complete set of common traits ($a_1, a_2, a_3 \dots a_n$) that can be attributed to a type. The second and third groups, that is A_2 and A_3 respectively, include buildings which share a complete set of common features the majority of which ($a_1 \dots a_k$) are constituent elements of the type T_1 derived from group A_1 , and the remaining features ($b_1 \dots b_r$) belong to other types identified either during the initial sorting or through another tentative type. These two cases are composite types. In conclusion, the composite type combines the majority of the characteristics of a pure type which is derived from the same tentative type, and few traits of another pure type (fig. 199, COMPOSITE 1 and 3) identified either during the initial step or through another tentative type (fig. 211, COMPOSITE 2).

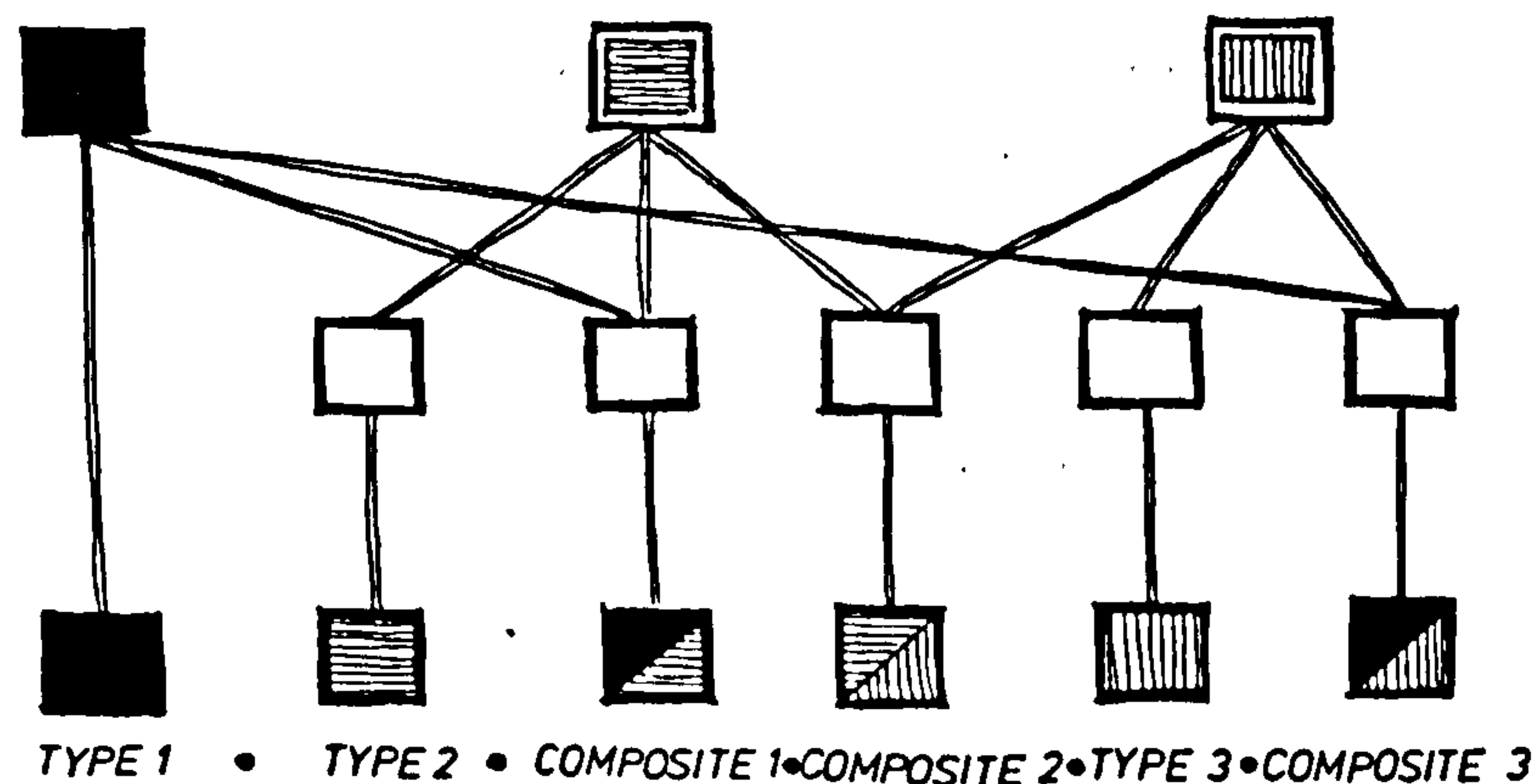


Fig. 211

In the third step I compare the types with the data available from buildings of which I have not had a complete series of drawings but only some partial information and mainly photographs. These mills seem to fit the established typology so far, but it would not be proper to consider them as part of the type-population.

In the final phase I name each type. The names consist of some identifying words which refer to the most important feature within the type or describe the type in an overall manner by embracing the majority of its elements.

Throughout the process of the identification of types few problems have arisen. The majority of them have occurred with a number of questionable mills which are not finally incorporated in the framework of types, and are analysed individually at the end of the section.

Nevertheless, there is a problem related to the sorting that has taken place. The important issue is whether it is legitimate to have a single-member type. Generally, the answer to this question is negative, since the idea of the single-member type contradicts the very meaning of the notion of type. The concept of type refers to a group of buildings sharing a complete set of common attributes. However, I have included a single-member type in the typological analysis of mills since the type-population depends on the size of the sample. This rather contradictory decision has been taken on the basis of additional information concerning mills both in Greece and abroad which do not belong to the sample but share common features with the single member.

The following figure (fig. 212) is a diagrammatic presentation of the process followed in order to identify the types of mills, the name of each type and the number of actual buildings which belong to every type.

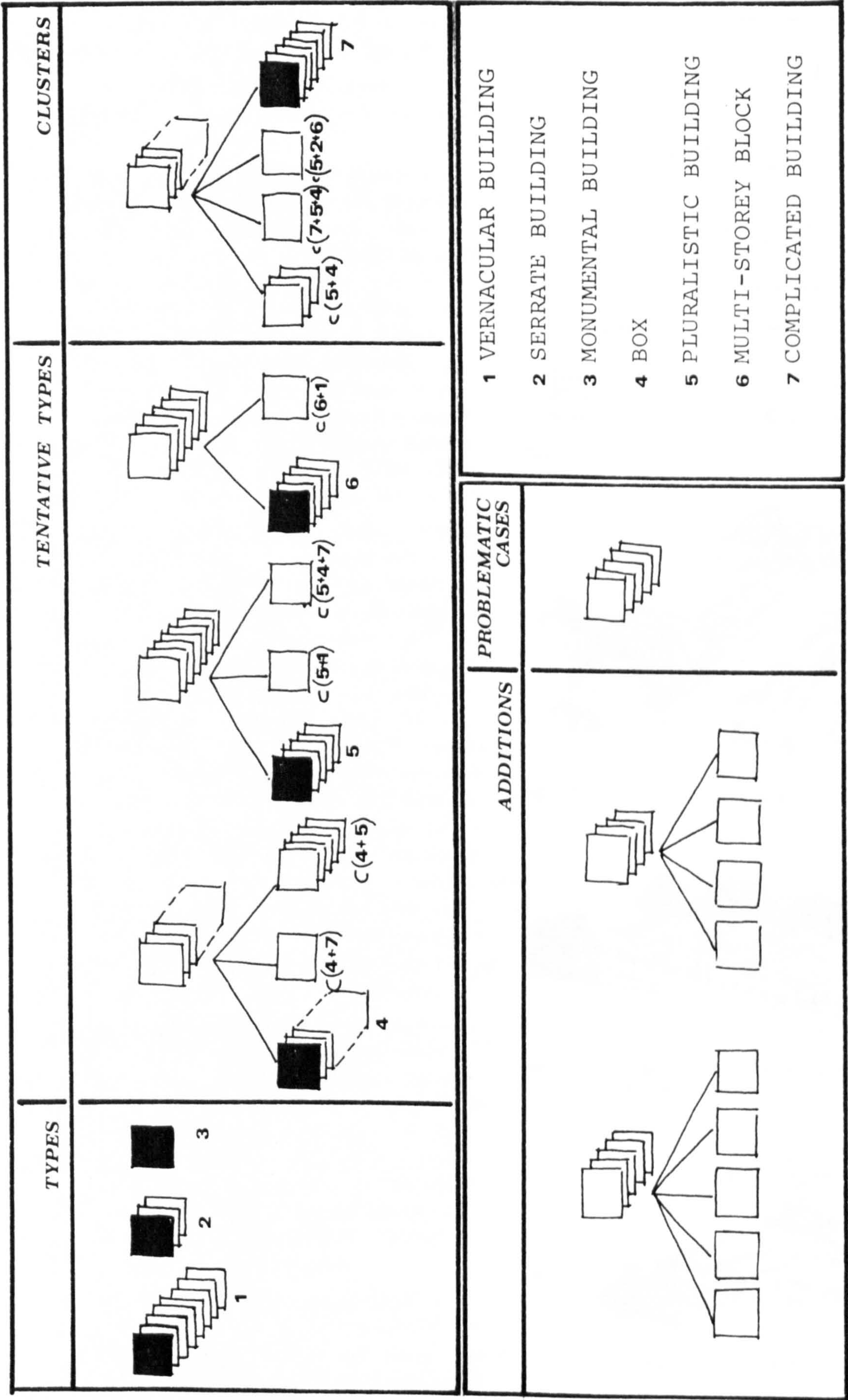


Fig. 212

5.2. DESCRIPTION OF MILL-TYPES

THE VERNACULAR BUILDING

Number of mills belonging to this type: **8**

0. The dominant feature: It has strong local quality and has been built using traditional methods and materials.
1. The articulation of spaces: The spatial composition is irregular, and the structure and sequence of spaces do not follow a clear pattern that can be represented with an abstract diagram. A large number of partitions separate the functionally different spaces; even the various phases of the production process are separated. The production process runs along many lines. The spaces of the administration in the majority of cases are located in a separate building (fig. 213 a,b,e,g,h) or on the first floor above the production hall (fig. 213 c,d,f)
2. The spatial volume: It is rarely a simple rectangular volume; it is either one volume with irregular bounding lines or usually a complex of volumes articulated by means of topological or geometrical relations⁵ (fig. 213). These are organized in such a way so as to form a closure or a linear configuration sometimes in parallel lines. The volume/s is/are small, horizontally extended and mainly one-storeyed but there are some parts which are two-storeyed. The form of the roof is gabled or hipped. The openings are small, rectangular and ordered. The linear sequential articulation of windows allows some one inside to have a fragmented picture of the outside. In general, the building volume is 'closed' concerning its relationship to the sky and stands heavily on the ground.
3. The formal structure: Casual. The treatment of the facades varies from cases where the flatness of the external walls is interrupted only by the openings to cases where a particular emphasis is given to local character with the use of characteristic motifs (openings, treatment of corners and bounding lines, special manipulation of materials in the ground floor, pediment treatment of the gabled roof).
4. The means of technical realization: The structural system is load-bearing and the building materials traditional (wood, stone, roof tiles); sometimes cast iron and steel.

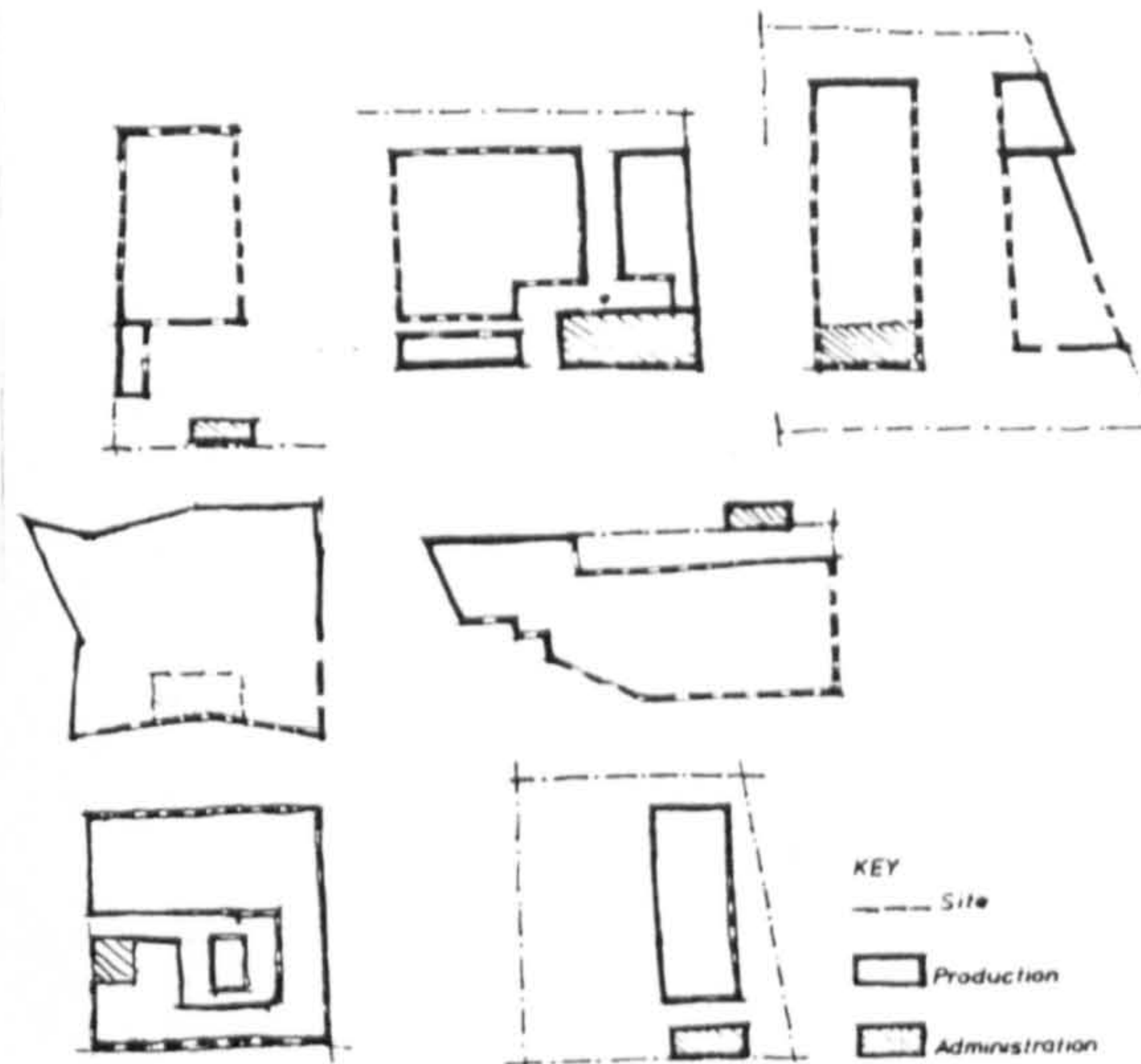


Fig. 213.

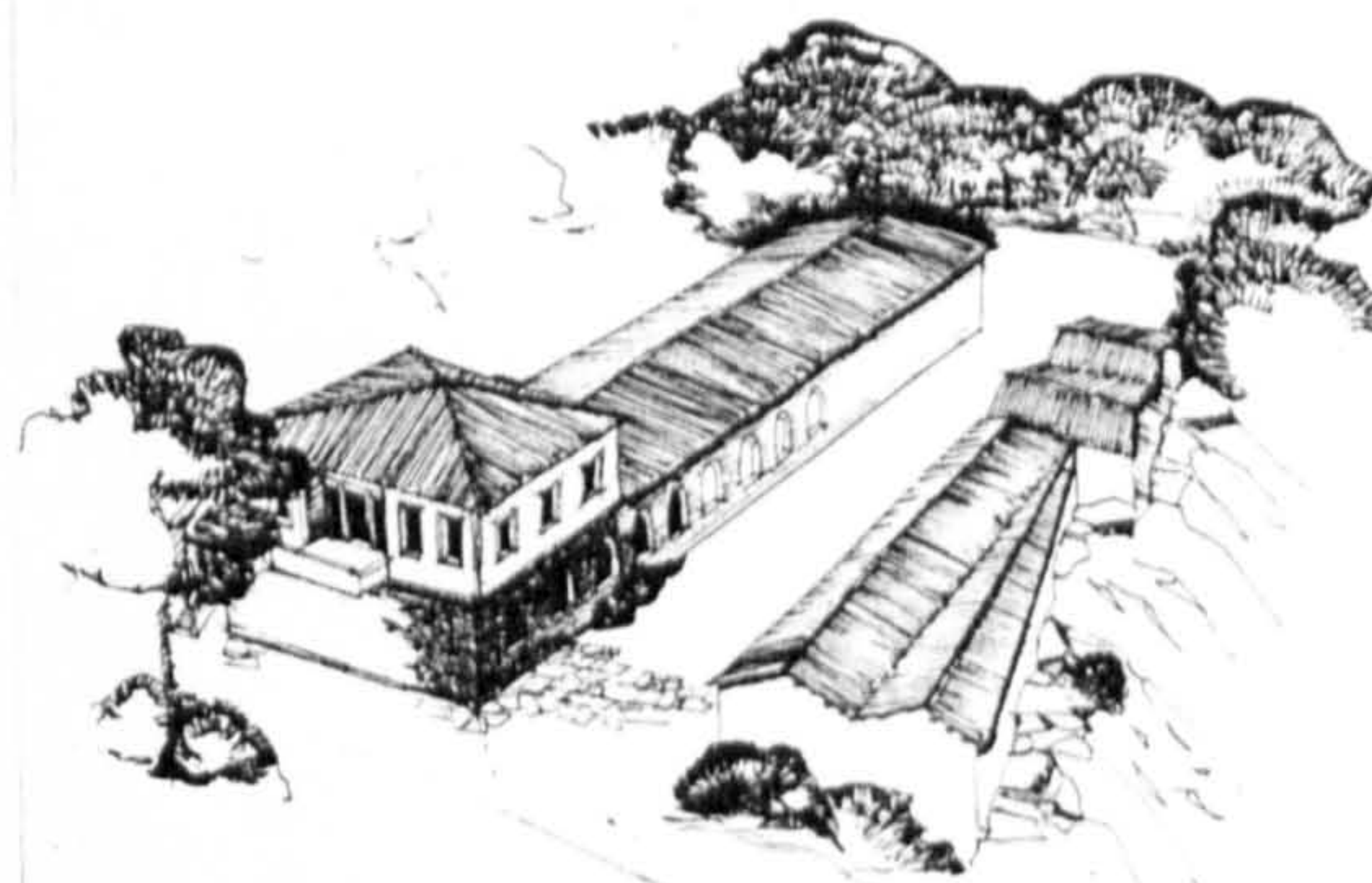


Fig. 214. 'Ifen, A. Hadjiantoniou & Co', (A.6)

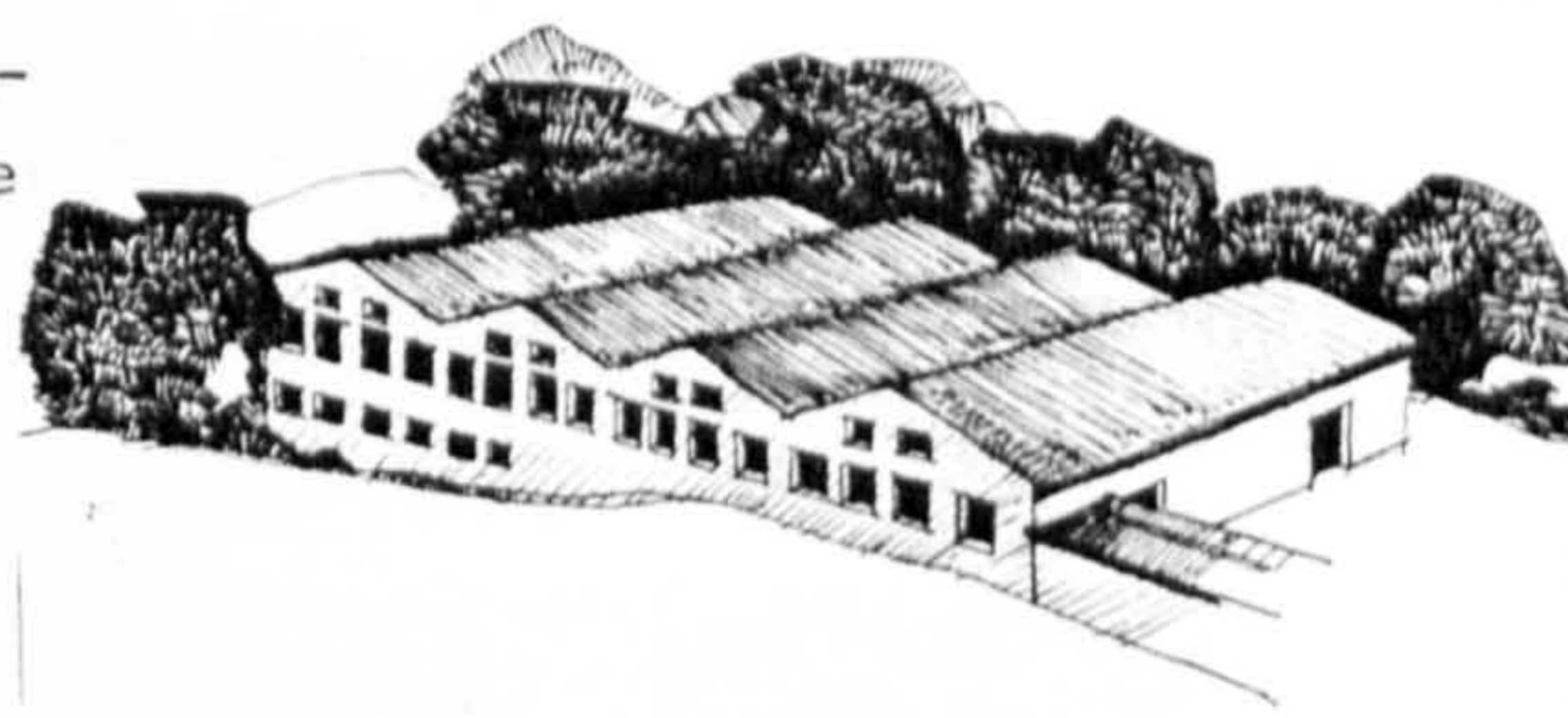


Fig. 215. 'Spinning and Weaving Mills of Edessa', (A.4)



Fig. 216. 'Barbetas', (A.8)

Number of mills belonging to this type: 3

0. The dominant feature: It has a dynamically extended saw tooth roof
1. The articulation of spaces: Simple, organized, without many partitions. The area of administration is always separated from the other spaces in a small building which is located in front of the main facade of the production hall (fig. 217). The production process is linear extended to one or two parallel lines.
2. The spatial volume: It is a dominant, simple, rectangular, horizontally extended volume with a dynamical saw tooth roof. It is always combined with the small separate building used for the offices. The two spatial volumes are lined up rigorously and mechanically on the basis of geometrical relationship i.e. axuality. It is a vertically 'open' building in terms of the shape of the roof and the inflow of light through the upper part of the building to the interior space. The openings are rectangular, uniform and distributed in a strict sequence. The inside-outside relationship is conditioned, as in the vernacular building, by the way the external walls are cut out with the openings. The people who are inside the building have a piecemeal vision of the outside environment since the distance between the windows is quite large.
3. The formal structure: The main building has a very simple formal language and contrast with the elaborate form of the small building which contains the offices. The bounding surfaces of the mill are interrupted vertically either by the water pipes or by the columns of the structure which are differentiated from the infill materials in terms of material, colour and texture. These linear elements are articulated in a repetitive, rhythmical way.
4. The means of technical realization: Skeleton frame structural system. Use of reinforced concrete for the structural frame, brick for the infill elements and roof tiles. Early examples use wood for the structural frame.

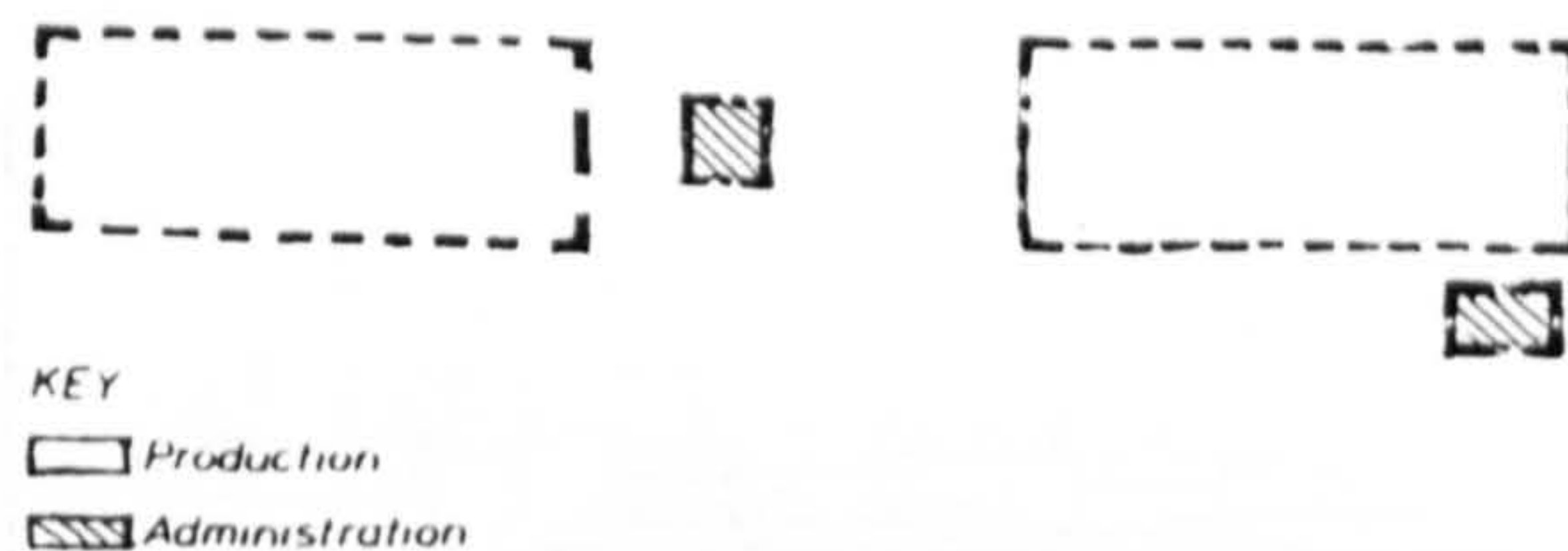


Fig. 217. Schematic plans of factories

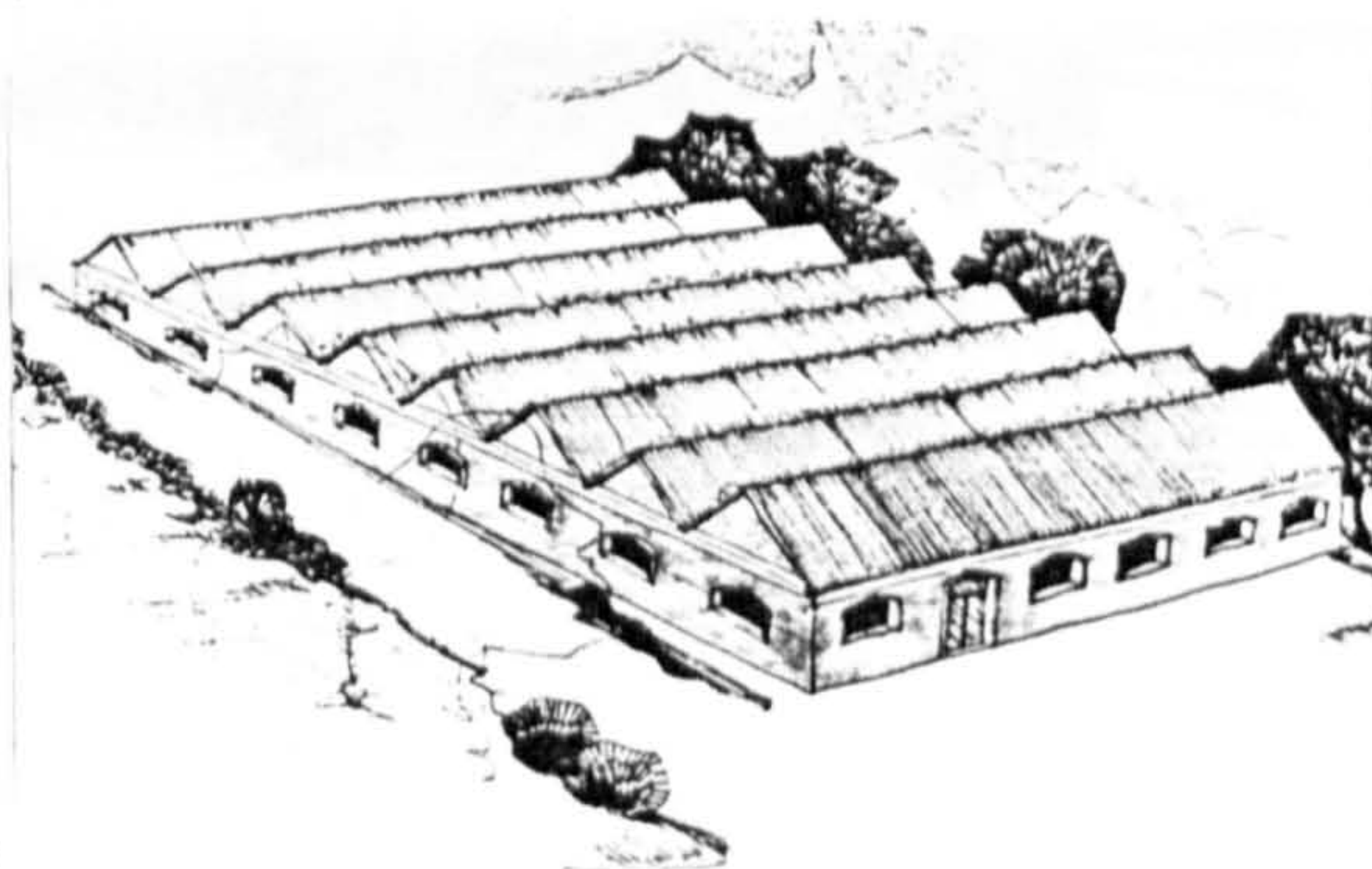


Fig. 218. 'Sefeco Wool Industry' , (A.11)

Number of mills belonging to this type: 1

0. The dominant feature: It is based on the transformation of a monumental style in an attempt to promote a particular image. It has an imposing style, rich motifs and details, and above all rich symbolic connotations.
1. The articulation of spaces: Simple and clear. The various activities are hierarchically and in zones organized (fig. 219). The offices are incorporated within the factory volume in the centre of the front zone. The production activity is in the central and main zone, whereas in the third zone the auxiliary facilities. The production process is simple and distributed to many levels.
2. The spatial volume: It is a large, high, monolithic, compact and earth-bound volume. with flat roof and orderly openings in continuous bands.
3. The formal structure: The qualities and the formal composition of this type are conditioned by the style which constitutes the area of borrowing. One can recognize the echo of classical principles: plasticity, pomposity, imageability, articulated order, axial and symmetrical composition of the main facade, tripartite composition of the facades, refined details. The articulation of the facades expresses the hierarchical relationship of the activities which take place within the building. The abstraction and the allusions of classical principles and details are present but they are restricted only to the bounding surfaces of the building.
4. The means of technical realization: Skeleton frame structural system. Building materials: reinforced concrete for the structural frame and brick for the infill elements.

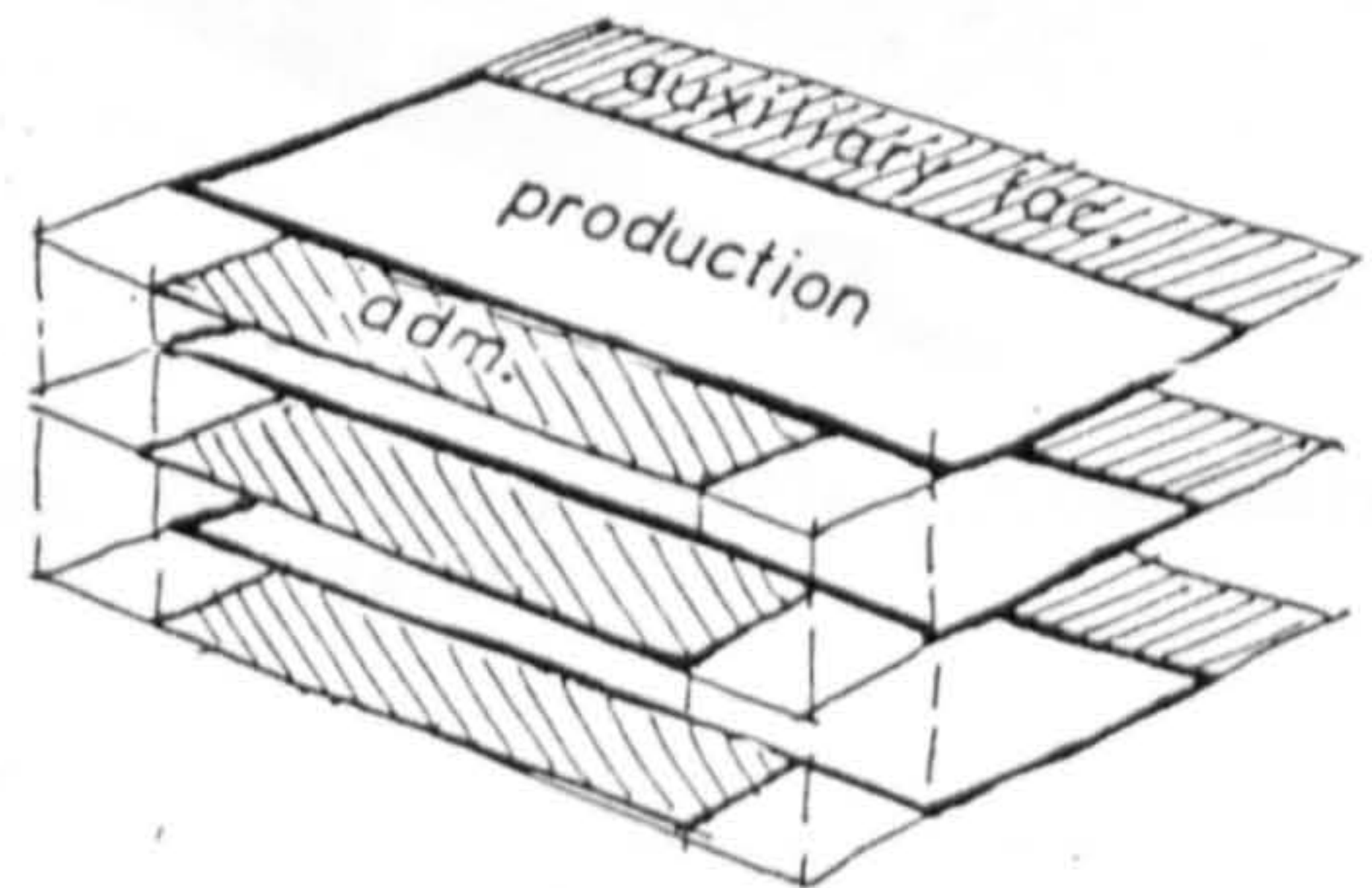


Fig. 219.

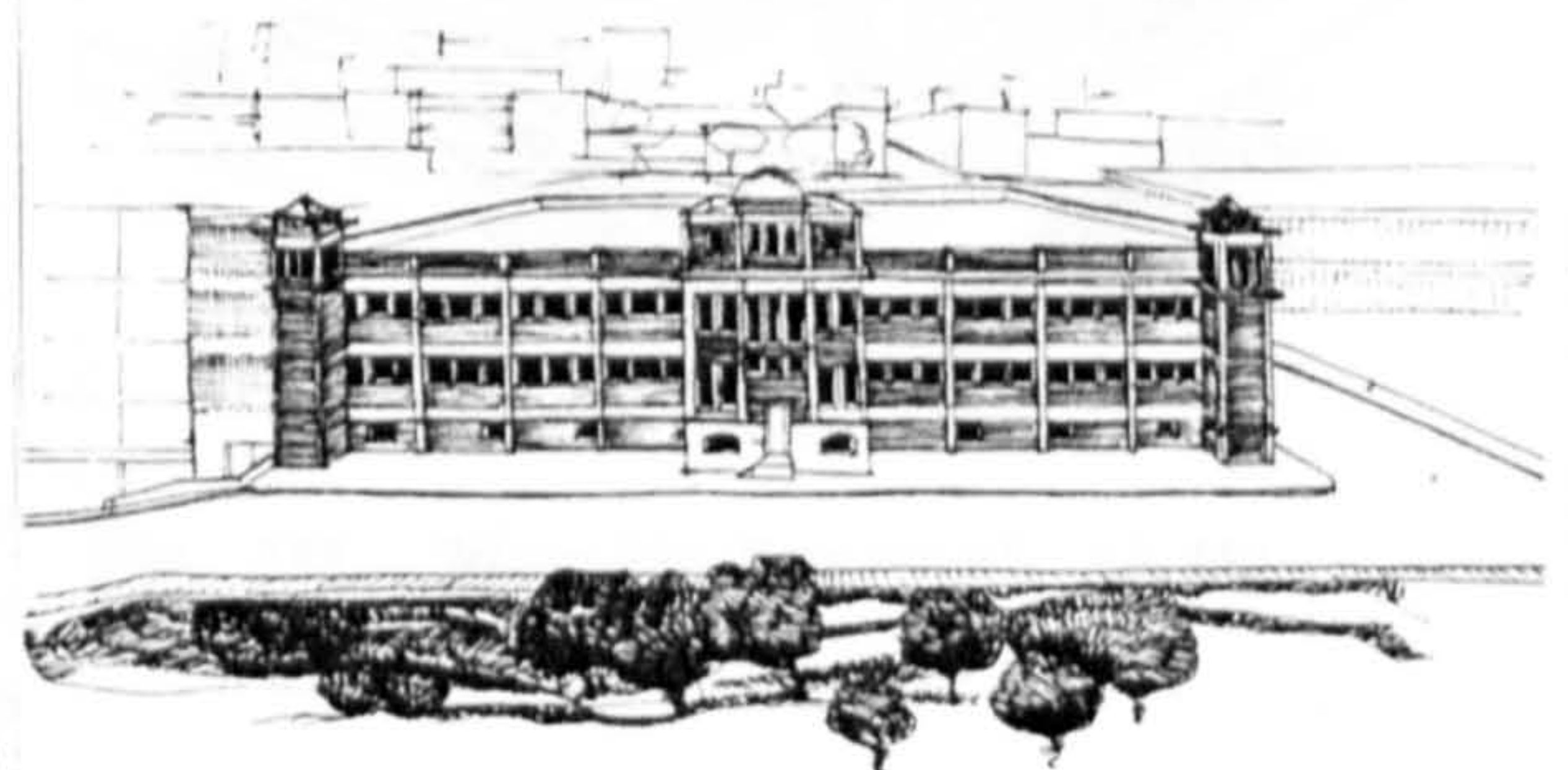


Fig. 220. 'Attica Spinning Mills' , (A.14)

Number of buildings belonging to this type: 6(1)*

0. The dominant feature: It has an ascetic formal language combined with a complex spatial organization and a variety of roofing systems (saw tooth roof, gabled, pitched, flat).
1. The articulation of spaces: Disorderly, irregular, complicated due to the partitioning of walls. It is very difficult to be represented with an abstract diagram. The production process also is disorderly, distributed to many levels and is irregularly interrupted.
2. The spatial volume: It is usually an unarticulated cluster of buildings or unarticulated juxtaposition of spatial volumes. The roof is not continuous and all-embracing. It is extended in different levels and in various forms, and creates the impression of a building which does not have a pure rectangular form but is a subtractive or additive transformation of it. There is a great variety of openings (continuous bands, small individual rectangular or square windows) which are distributed in many ways allowing different views from the inside.
3. The formal structure: The building is plain, unembellished with sharp edges, the result of the synthesis of pure stereometric volumes. There are no variations of material, texture or colour. The form does not explicitly express the inside functions. It looks chaotic and vague. It has no architectural quality and bears no relationship to its environment.
4. The means of technical realization: Skeleton frame structural system. Building materials: reinforced concrete for the structural frame and brick for the infill elements, roof tiles for the saw tooth, hipped and gabled roof.

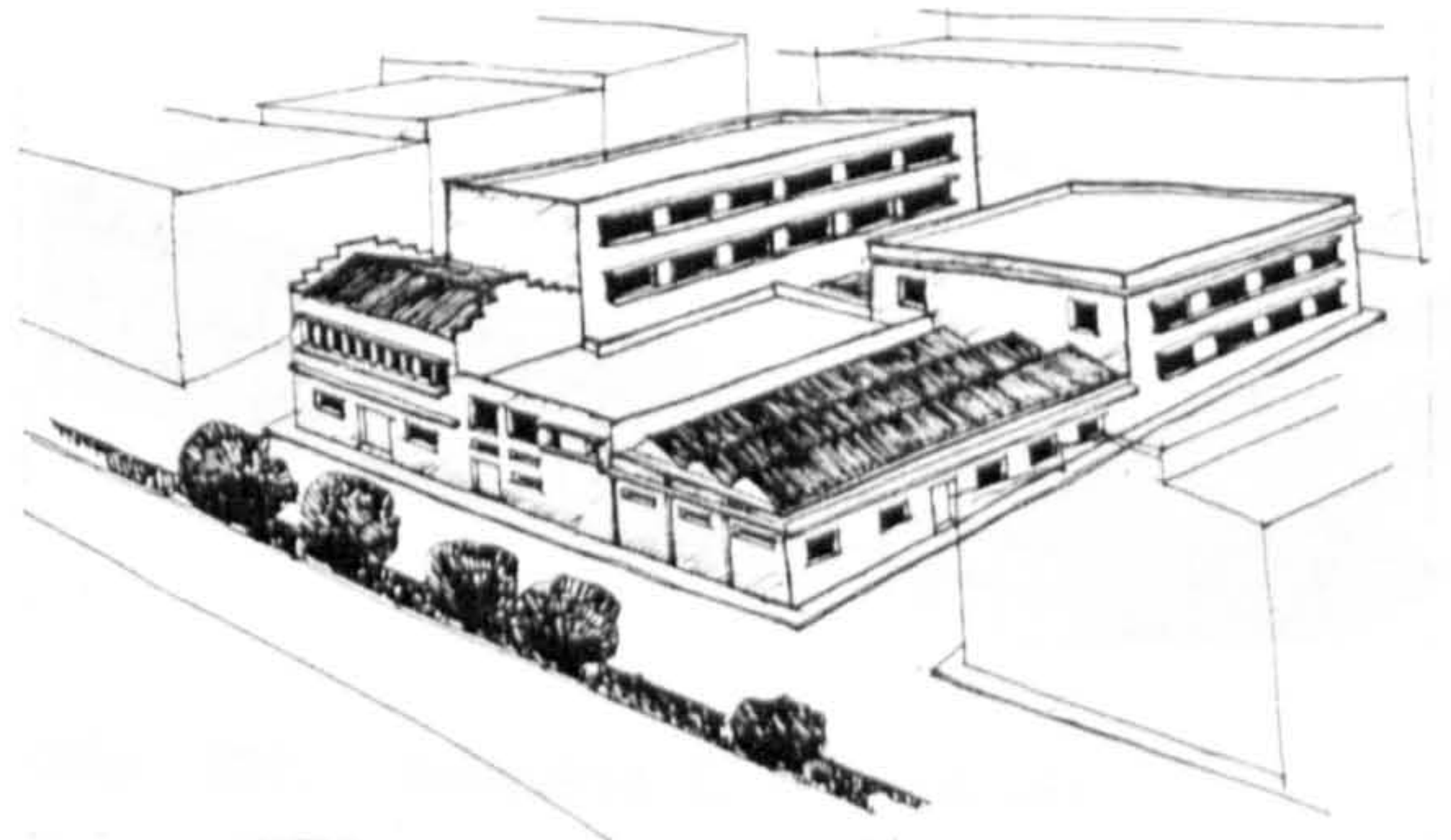


Fig. 221. 'Ilios Textile C.S. Constantinides', (A.16)

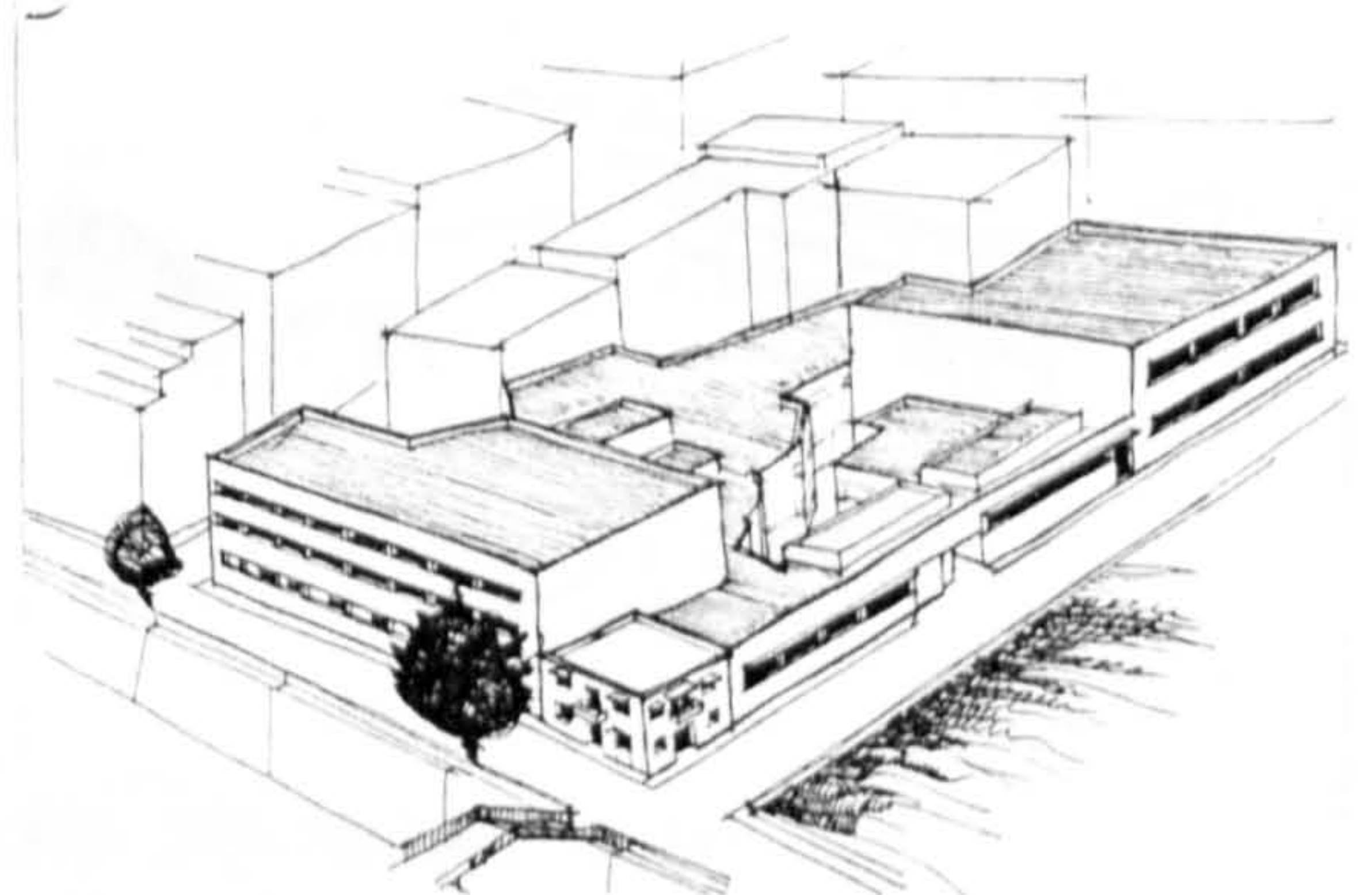


Fig. 222. 'Minaidis Fotiadis', (A.15)

* The number in parenthesis refers to those mills as they appear after various additions.

Number of mills belonging to this type: **5,(1)**

0. The dominant feature: The *multi-storey block* mill has a dull and voluminous character combined with a simple and monotonous formal language.
1. The articulation of spaces: The structure of the inner spaces is more or less clear and based on zoning of the functionally different areas. The production hall is open without partitions and the production process is continuous and extends to various storeys. The offices are usually in the first floor close to the main facade of the building.
2. The spatial volume: It is large, high, stately, compact and earth bound. Its particular character consists in a solid and heavy appearance. The flat roof occasionally varies in level. The openings extend from column to column and follow the same pattern in all floors providing an open view of the outside world.
3. The formal structure: It is very simple. The surface of the windows and sometimes the external columns interrupt the flatness of the facades in a rhythmical repetition. The bounding surfaces enclose the inner space in a neutral envelope without revealing the variety of the inner activities; only the entrance and sometimes the offices are differentiated and their position emphasized.
4. The means of technical realization: Skeleton frame structural system. Building materials: reinforced concrete for the structural frame and brick for the infill elements.

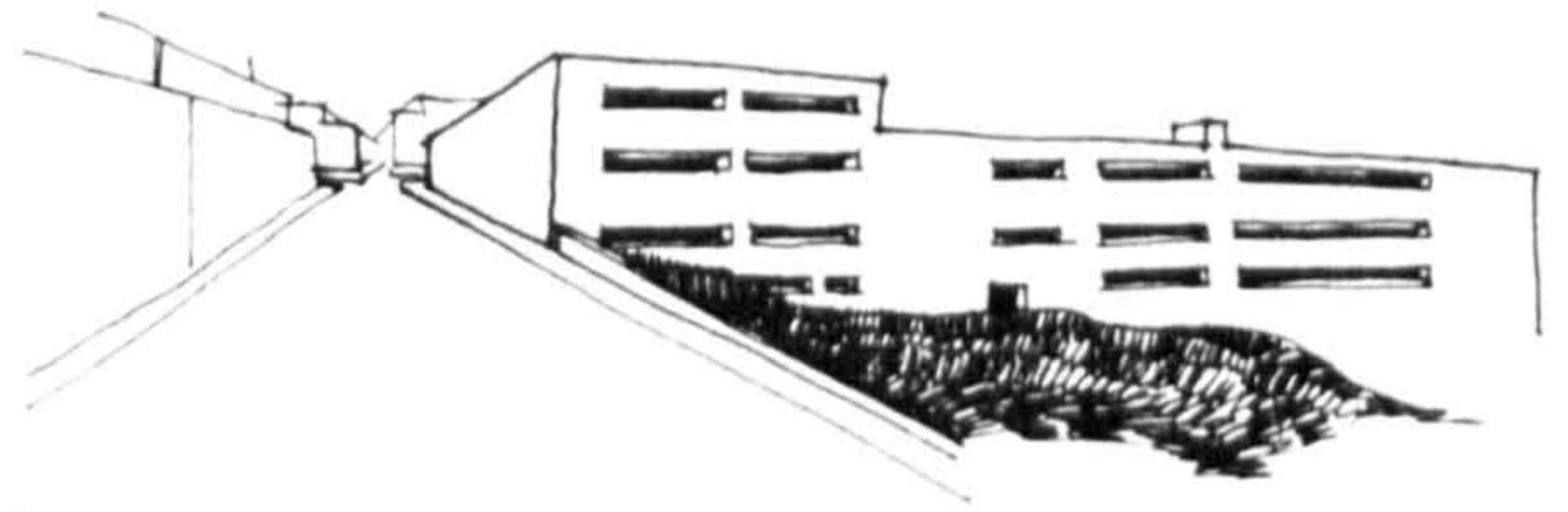


Fig. 223. 'Fhareron Spinning & Weaving Mills', (A.18)

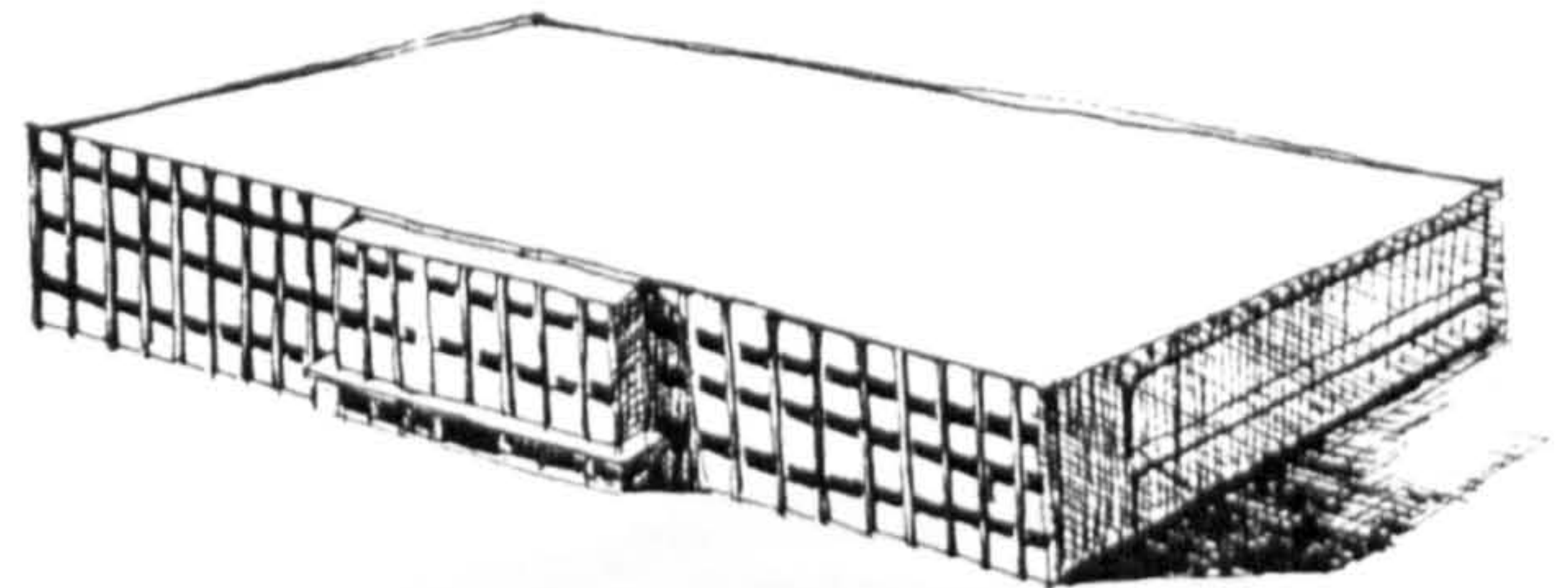


Fig. 224. 'Mouzakis E.I.D.', (A.39)

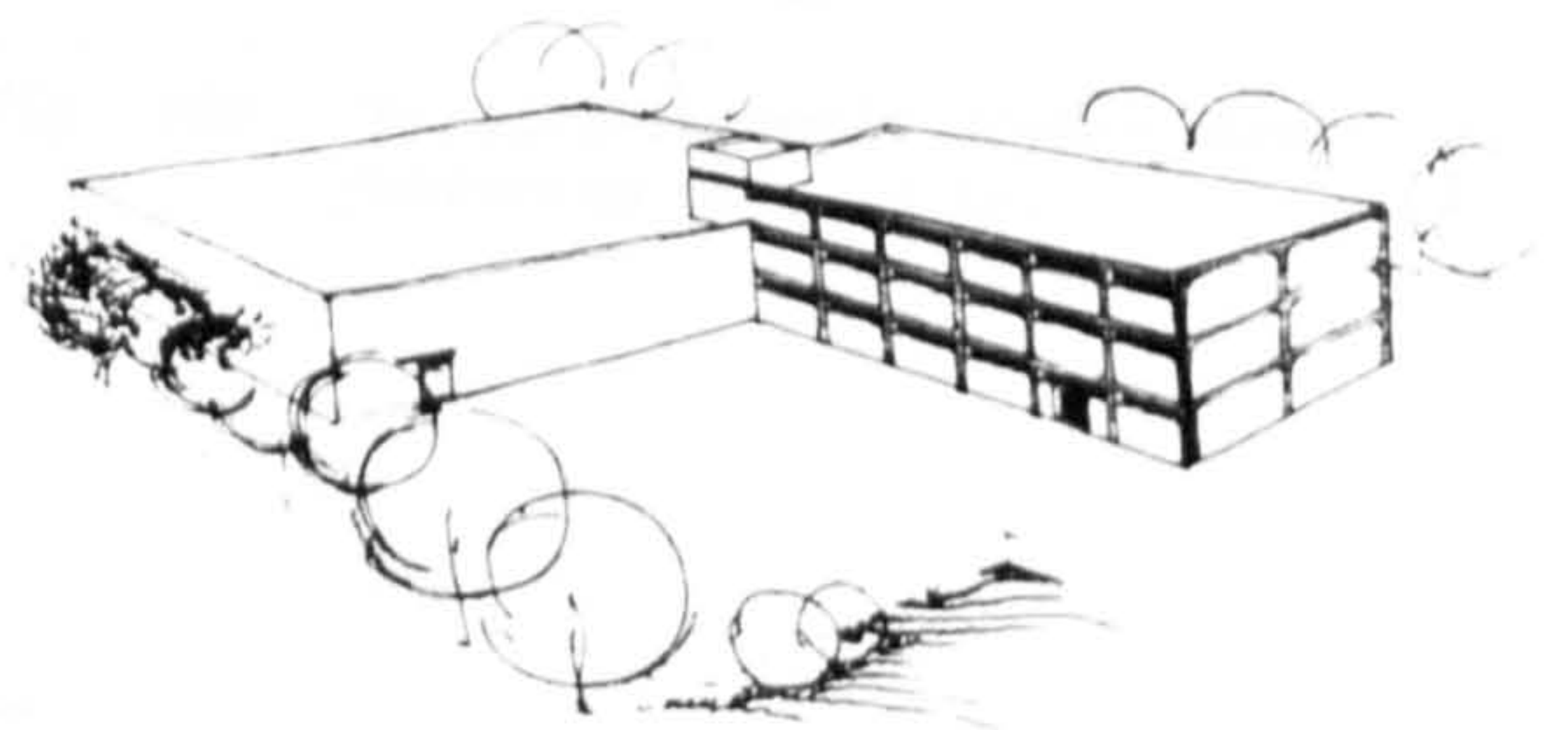


Fig. 225. 'Mavis', (A.38)

Number of mills belonging to this type: 5

0. The dominant feature: The pluralistic mill building is distinguished by a clear spatial organization and the use of rich formal language combined with an individual characterization of the functionally different parts of the building.
1. The articulation of spaces: They are rationally organized and hierarchically composed in an additive plan. The inner space is to a great extent 'open' since the partitioned walls are not many. The production process is continuous extended to one line.
2. The spatial volume: The building is not concrete and rigid but looks more like a fusion or cluster of many volumes articulated according to a functional taxonomy. It is large and horizontally extended. The roofing system is based on a wide repertoire of flat, gabled and saw tooth roofs. Their synthesis contributes to the interesting interplay of the building with the sky. The inside-outside relationship is usually complex as a result of the variations of size, form and distribution of windows. There is not always visual communication between the inside and the surrounding environment since many of the continuous window bands are narrow and high, and are treated as means of illuminating the building.
3. The formal structure: The pluralistic building has a disciplined articulation of the facades based on consistent principles and characterized by a rich handling of the formal vocabulary.
4. The means of technical realization: Skeleton frame structural system. Building materials: reinforced concrete and brick.

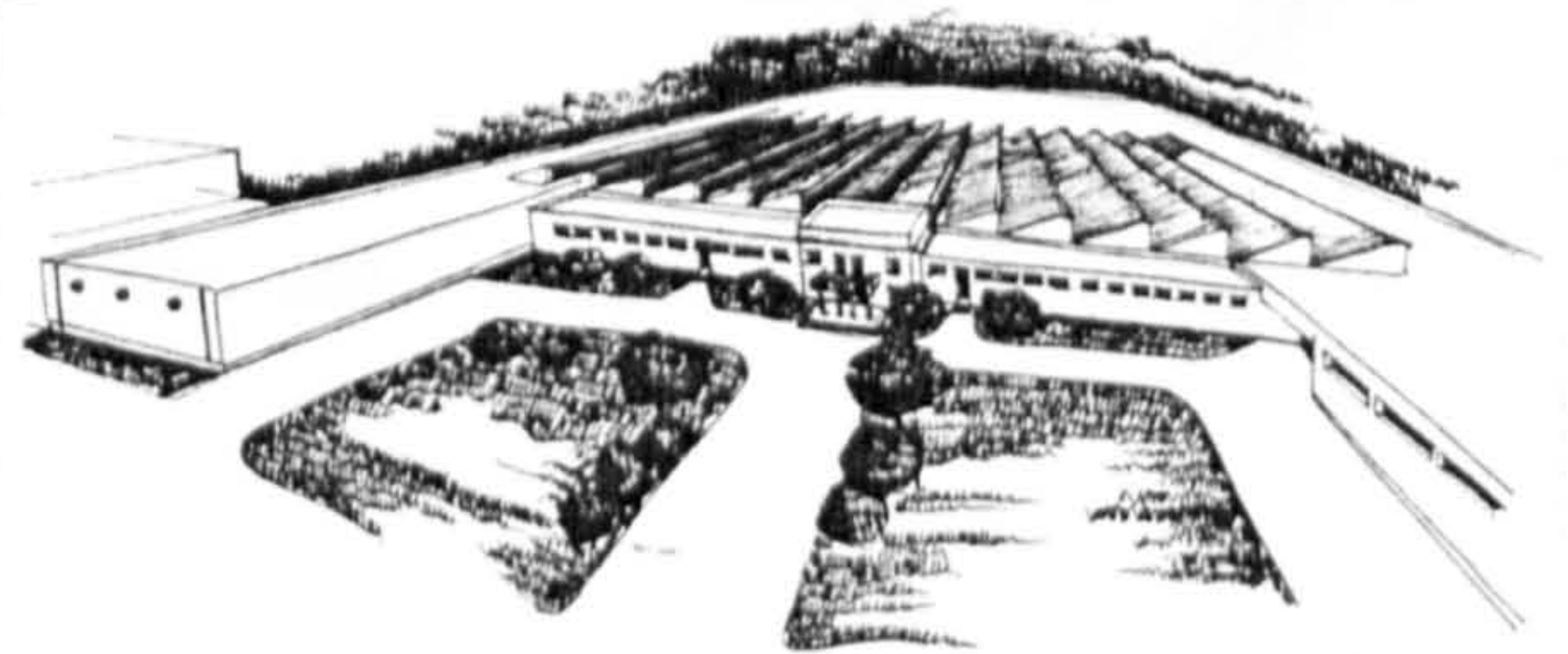


Fig. 226. 'Piraiiki-Patraiki Cotton Manufacturing Co', (A.22)

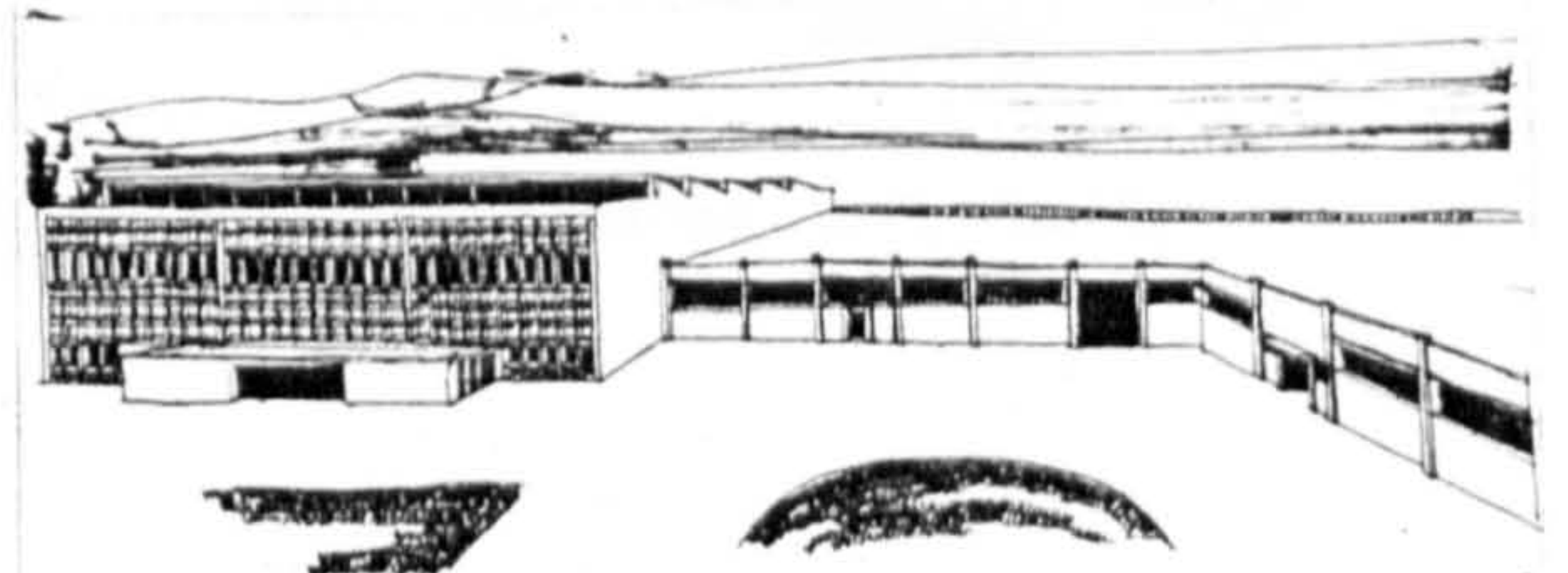


Fig. 227. 'Sacalides, J', (A.28)

Number of mills belonging to this type: **10**

0. The dominant feature: The box is a long, rigid, all-embracing and nearly windowless container.
1. The articulation of spaces: There is a clear distinction between the activities of production and the rest, concretized in two - or three - zoned articulation of the plan. The production hall is very large, oblong, open and completely one. The production process is absolutely linear, clear, orderly and extended in one floor.
2. The spatial volume: It has a massive appearance. It is a large horizontally extended earth-bound and strictly rectangular building. Variations in the shape of the roof (flat, curved, pitched) do not affect the general image of the building as a rigorously oblong, sharp-edged volume. Windows are almost absent.
3. The formal structure: It is simple and monotonous based on the repetitive and rhythmical use of linear elements (external columns of the structure, air-conditioning terminal units) which interrupt vertically the facades of the building. There are variations of material, colour and texture. In general, this building gives the impression of a cool, anonymous envelope.
4. The means of technical realization: Skeleton frame structural system. Building materials: Reinforced concrete and steel for the structural frame, and brick, or prefabricated panels for the infill elements.

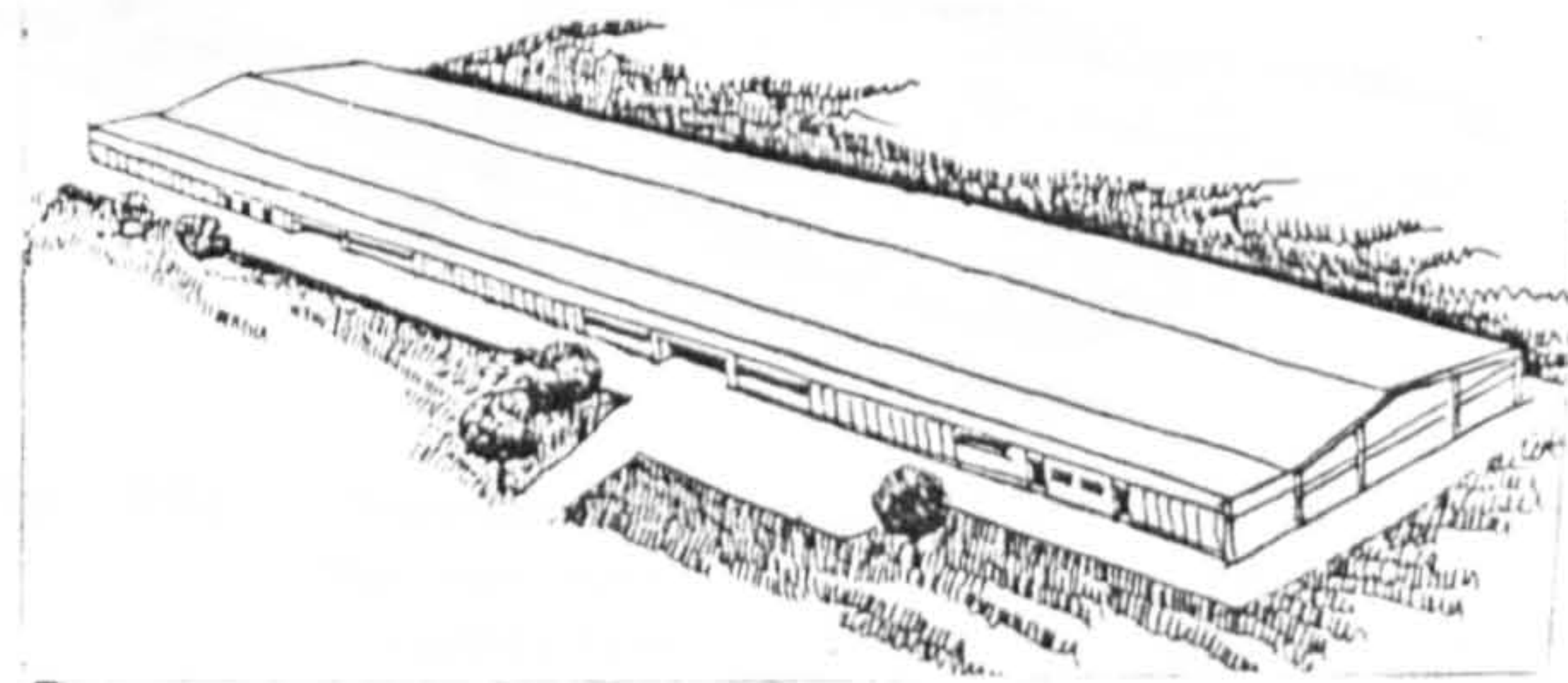


Fig. 228. Abatzoglou (A.40)

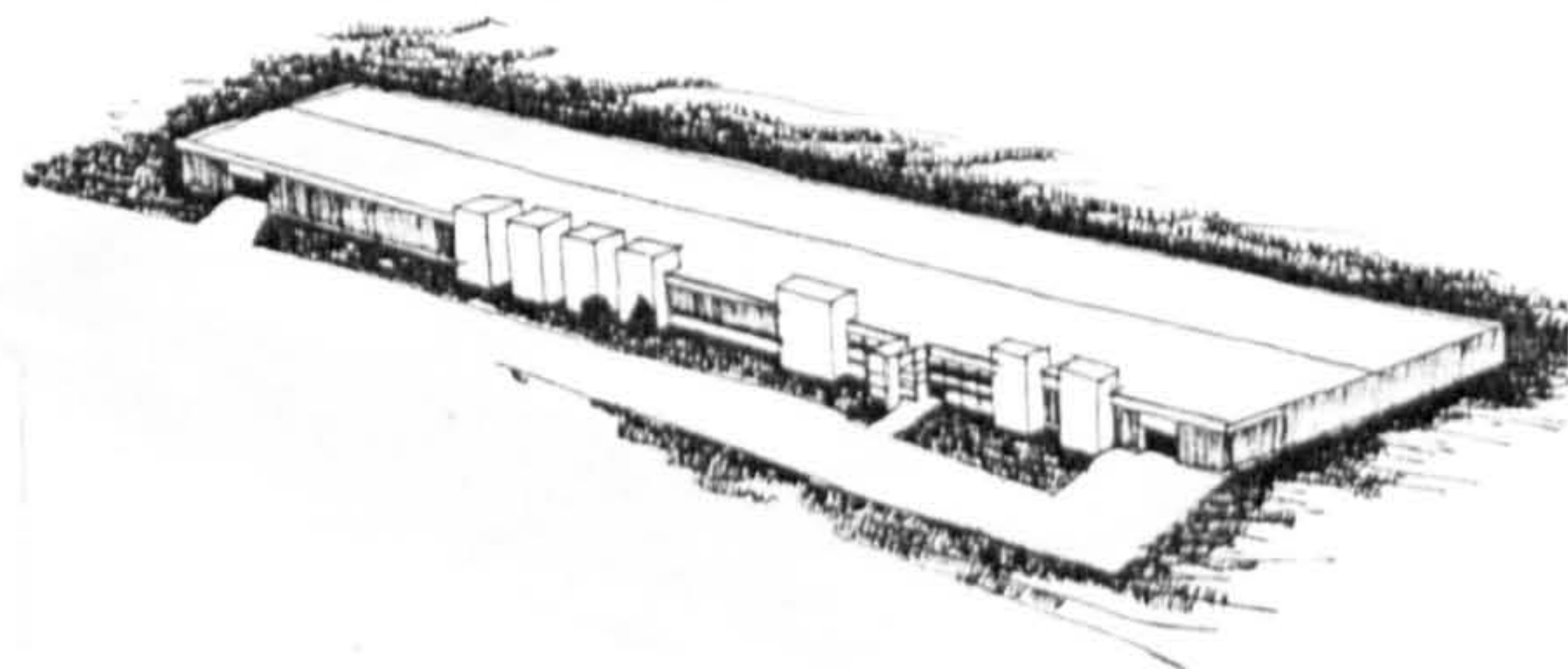


Fig. 229. 'Hellenic Fabrics', (A.51)

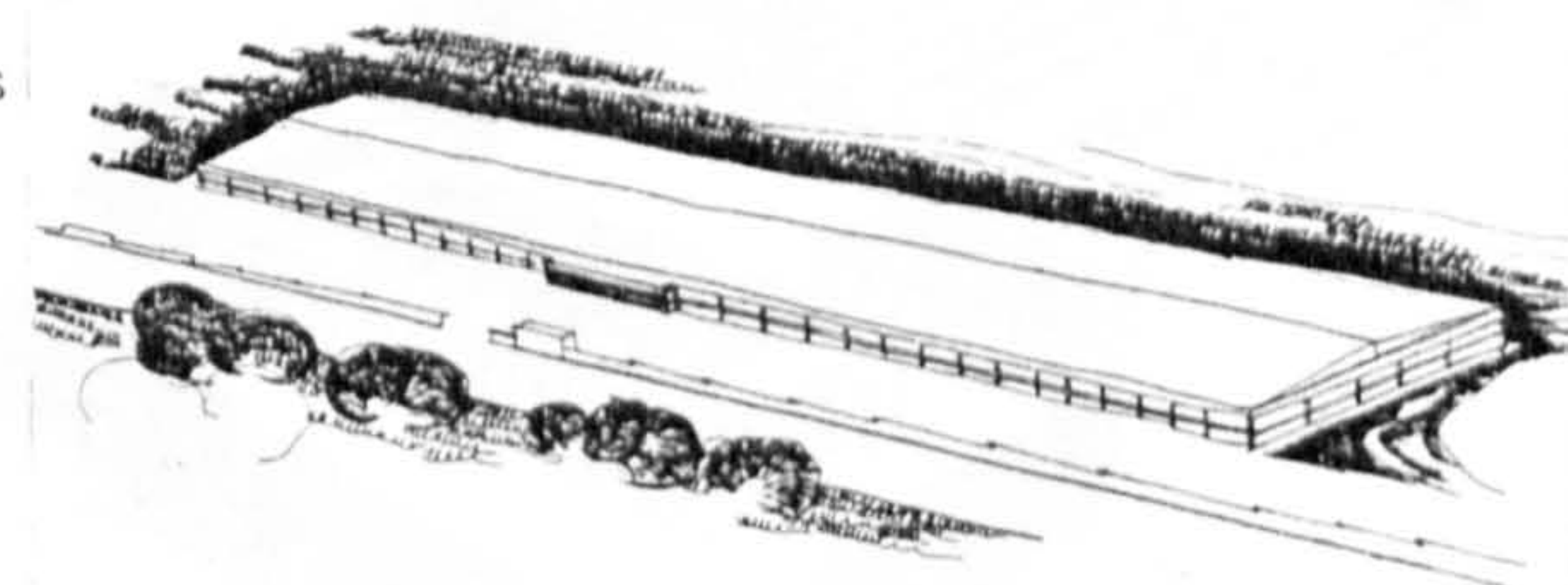


Fig. 230. 'Kriticos, H.', (A.55)

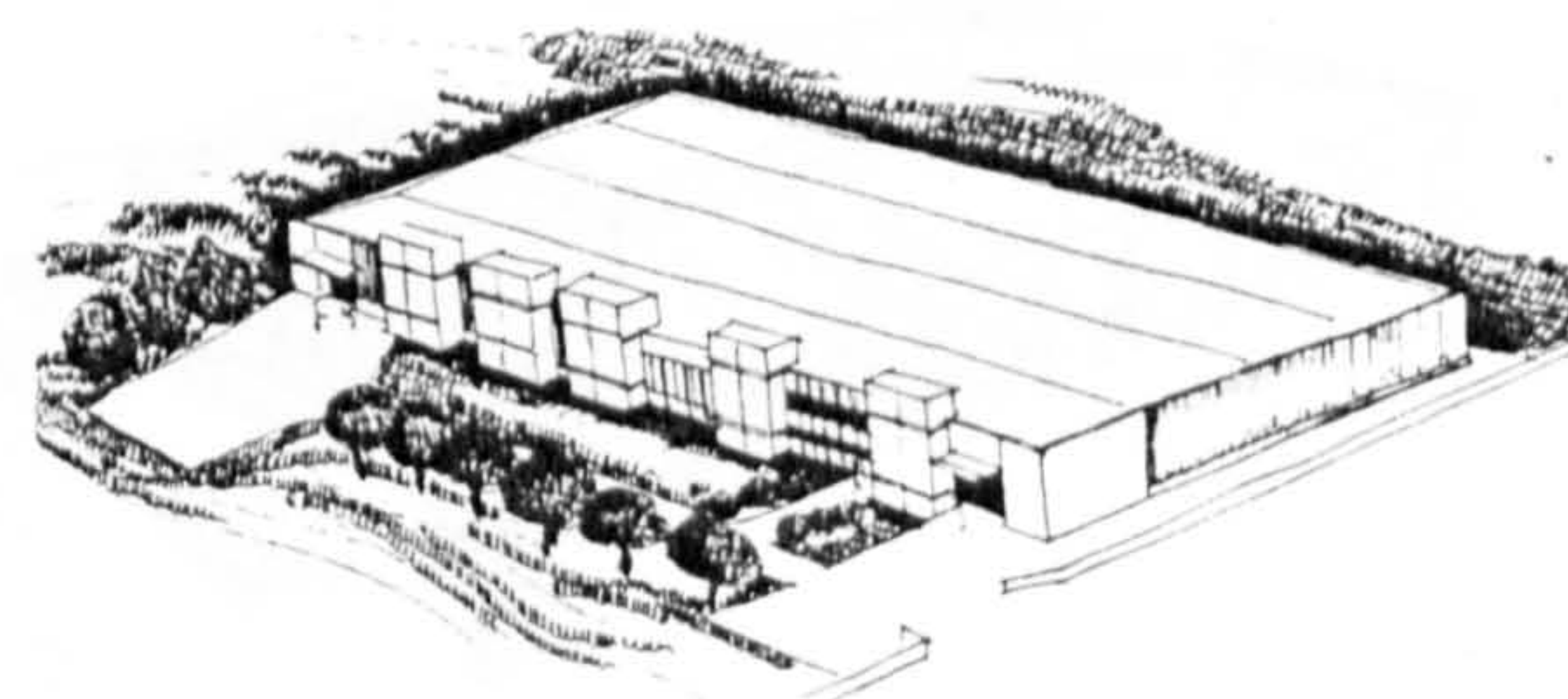


Fig. 231. Iliotex (A.50)

The types which have been identified so far, do not always appear in a pure form. Often they appear as parts of complexes. This occurs in three circumstances: firstly, when a new building is constructed as an addition to an old one and is based on a different type than the existing (fig. 232); these can be described as adjacent types or types in a cluster. Secondly, when an old mill is transformed due to the needs of the production process, or the environmental conditions, as for instance in the case of the PIRAIKI-PATRAIKI mill in N.Ionia (fig. 233), where the boarding up of side windows and the whitewashing of the saw tooth roof windows, resulted in the transformation of a *serrate building* to a composite one which interweaves the characteristics of a *serrate* and a *box*. Finally, a composite type may appear when a new building as a totality is a manifestation of a fusion of types (fig. 234, 235, 236) Of all types considered, one is dominant since most of the characteristics of the mills fit to this type with the exception of a few of them which derive from other type or types.

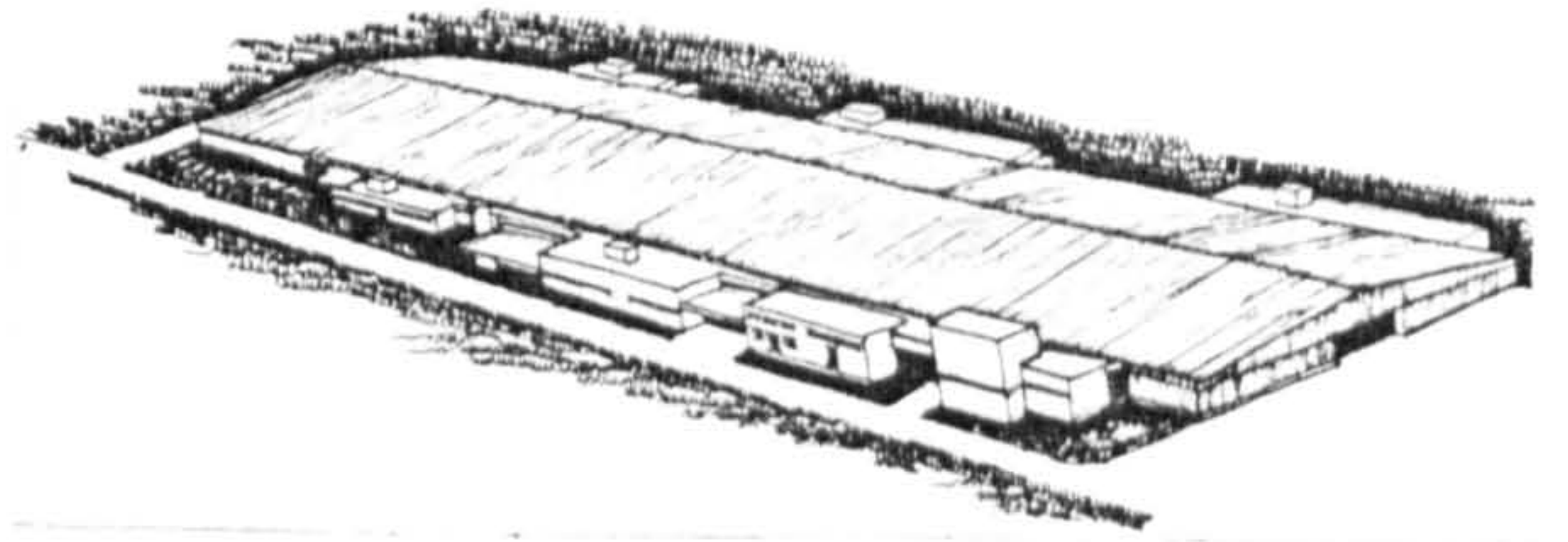


Fig. 234. 'Preveza Spinning Mills', (A.46). One can notice a fusion of the characteristics of a pluralistic building and of a box. It is basically a pluralistic building which embodies some of the qualities of the box: the impression of a windowless container the fluid inner space, the articulation of spaces in zones, the rigid and cool character

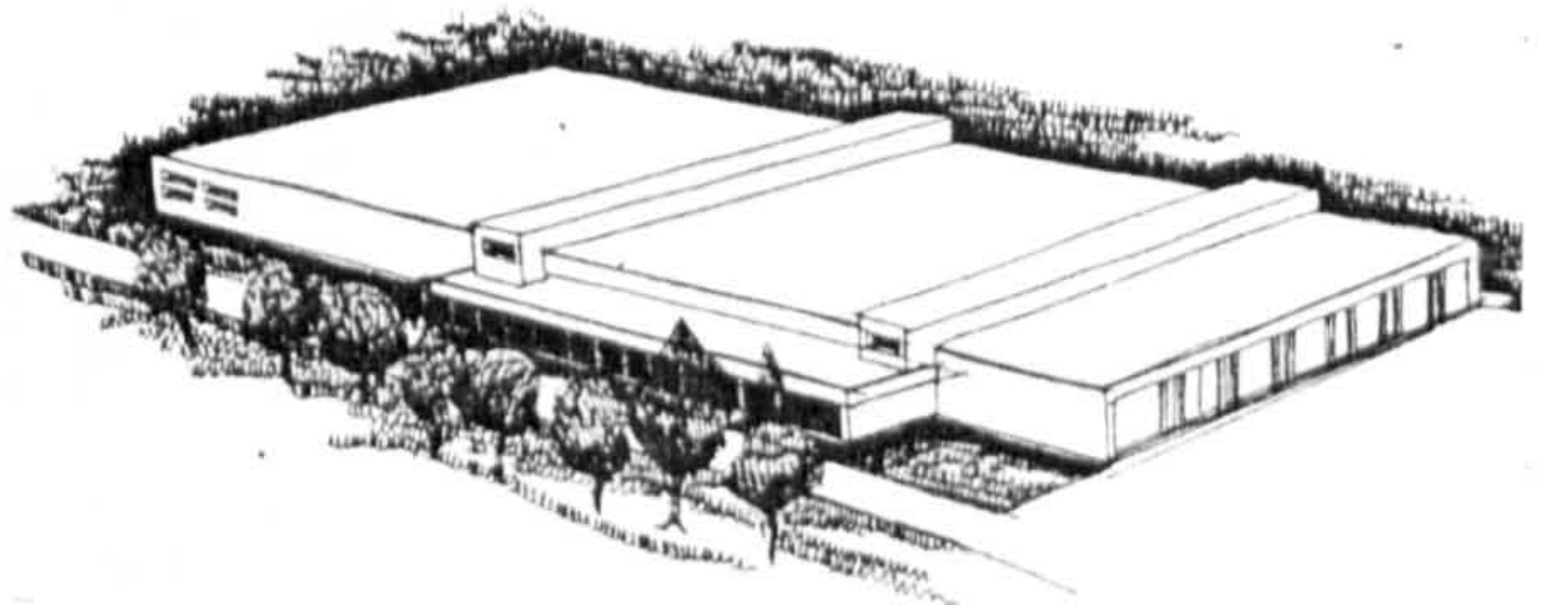


Fig. 235. 'Maragopoulos', (A.45). It combines characteristics of a pluralistic building and a box.

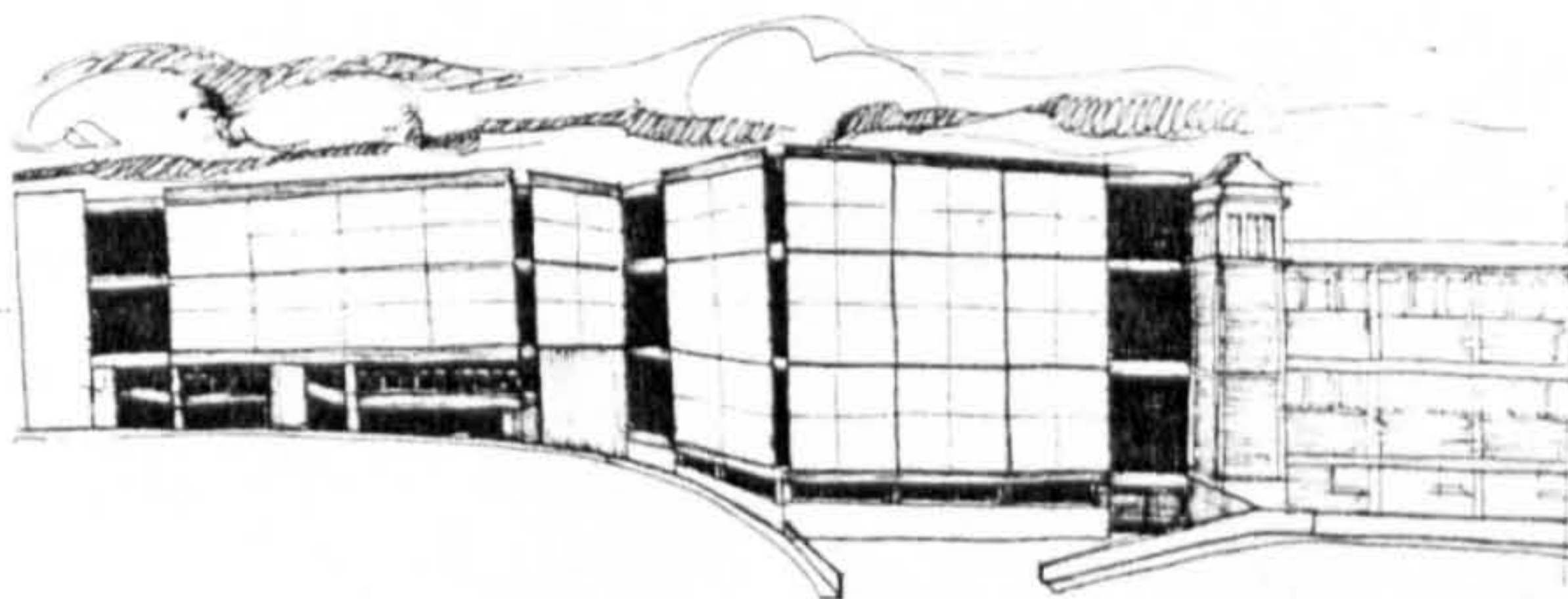


Fig. 232. Recent addition to 'Attica Spinning Mills', (A.14). It unites without interweaving the qualities of a monumental and pluralistic building

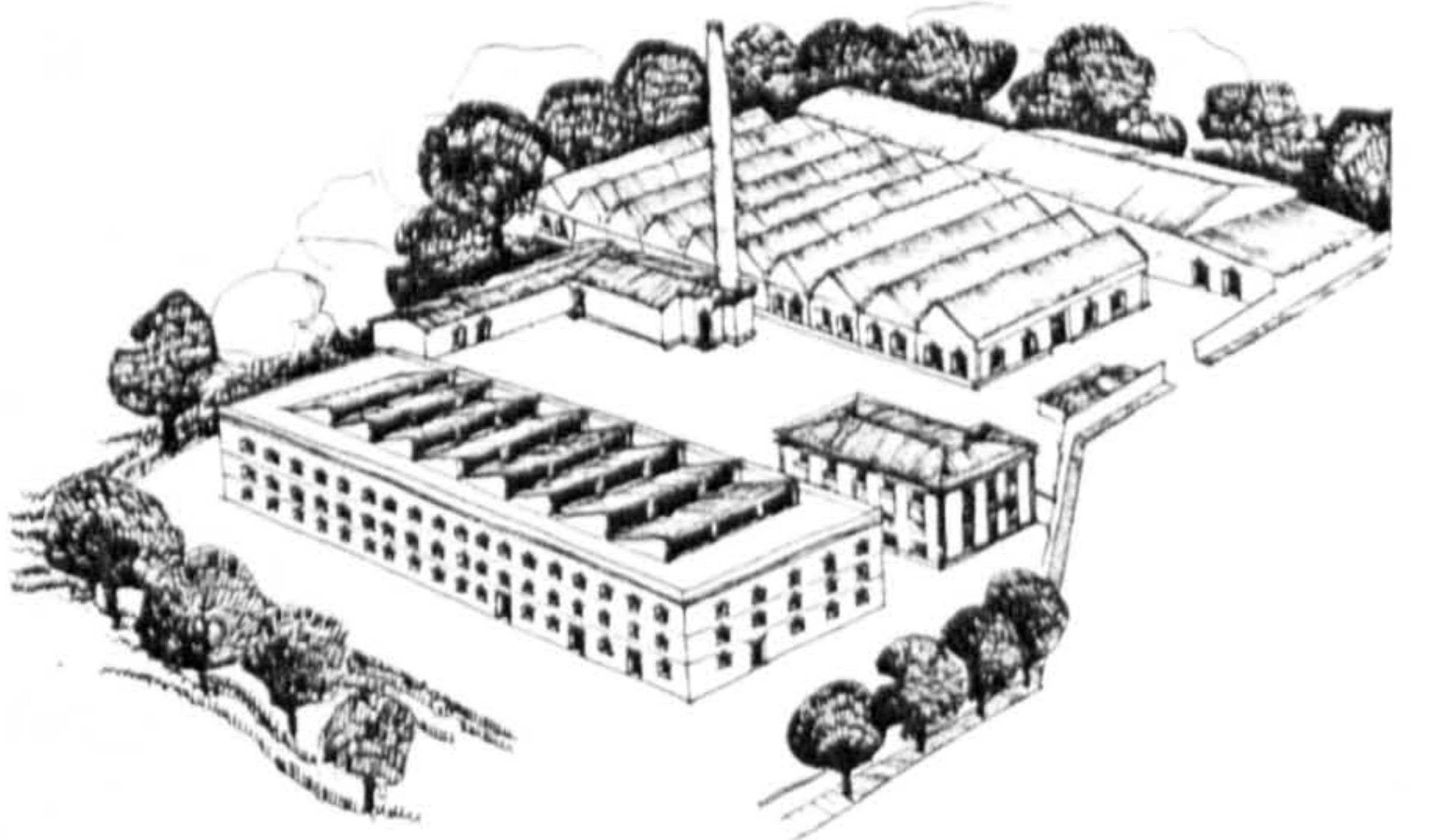


Fig. 236. 'Pella-Olympos, Maced. Spinning & Weaving Mills' (A.10). This cluster concretizes features of a pluralistic building combined with those of a serrate and a multi-storey block.

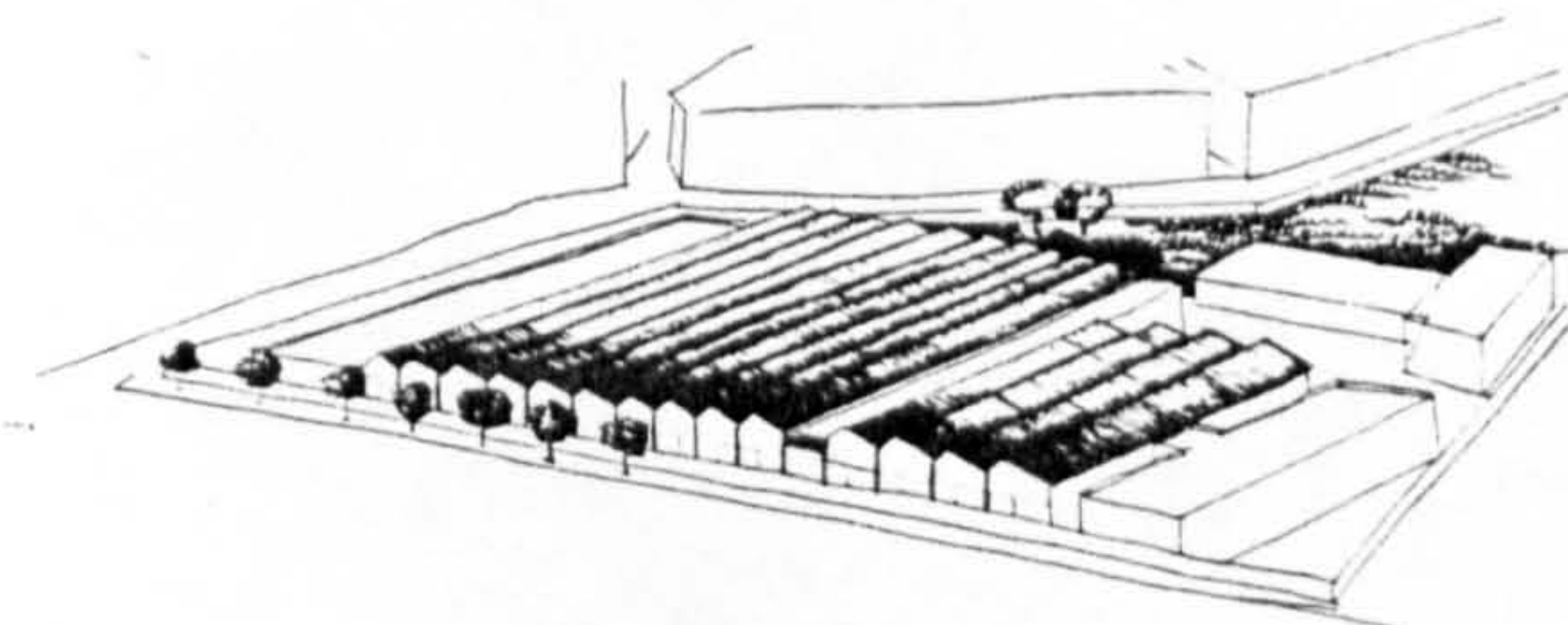


Fig. 233. 'Piraiiki-Patraiki Cotton Manufacturing Co', (A.13)

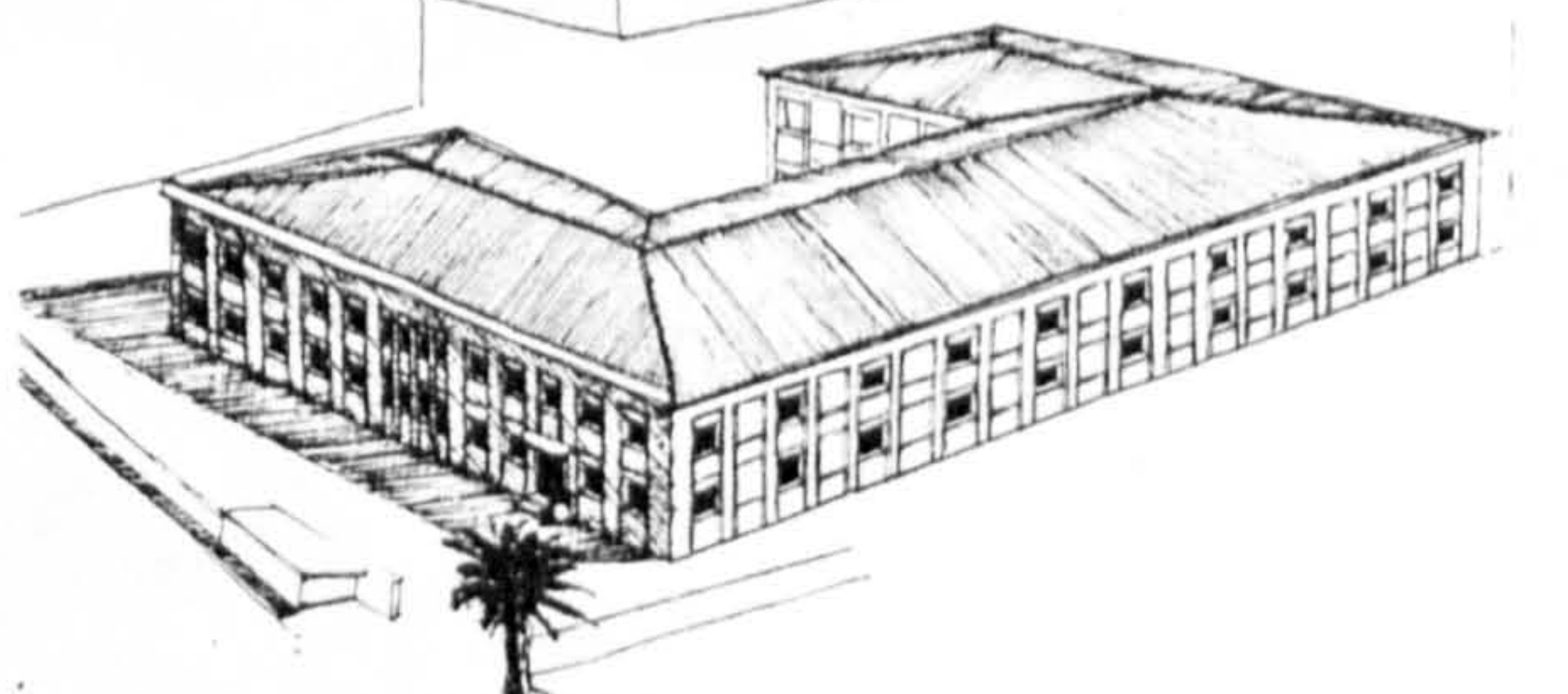


Fig. 237. 'Mouzakis', (A.23). It combines features of the multi-storey block with those of the vernacular building

Problematic cases

Despite the fact that the composite type functions as a 'catchall' for every building, which is not a manifestation of a pure type, there are four mills of the sample which do not fit to the established typology so far not even as composite buildings.

The first is SOURNOPOULOS mill (fig. 238) which has some of the characteristics of a *pluralistic building* e.g. the clear spatial organization, the rationally organized additive plan, the frame structure and the disciplined articulation of the facades based on consistent principles. However, the roofing system, the inside-outside relationship, the articulation of inner spaces, and the all embracing volume are bits of other types. Furthermore, the rich handling of the formal vocabulary - one of the main characteristics of the *pluralistic* - is confined only to the administration building, and even the individual characterization of the functionally different parts of the mill is restricted only to the distinction between the administration and the rest of the facilities.

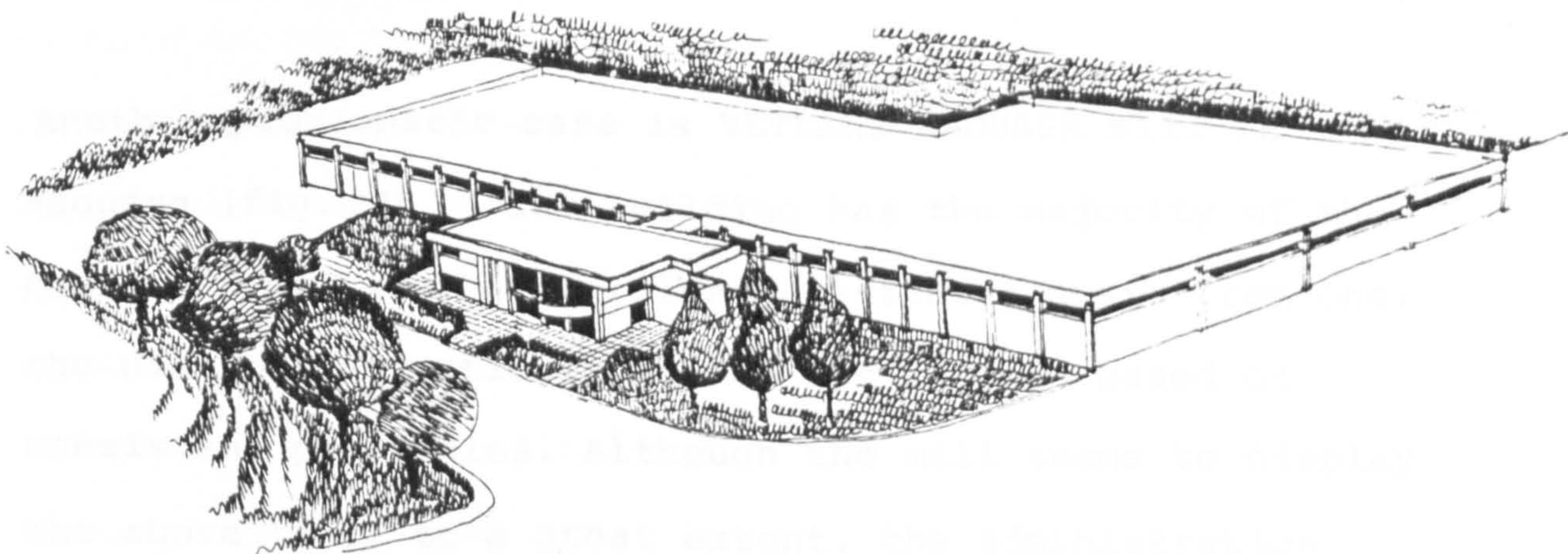


Fig. 238. 'Sournopoulos', (A.44)

The second case is SYROS SPINNING MILL (fig. 239) after the addition constructed in 1973. The old mill is a clear *vernacular building*. The new building is a very small extension of the old production hall of the mill. It repeats the shape of the roof of the existing *vernacular building* and abandons the rest of its characteristics (traditional materials, inside-outside relationship, kind and size of openings, load-bearing structural system). The new traits can be attributed individually to other types and clearly they do not belong to a particular one.

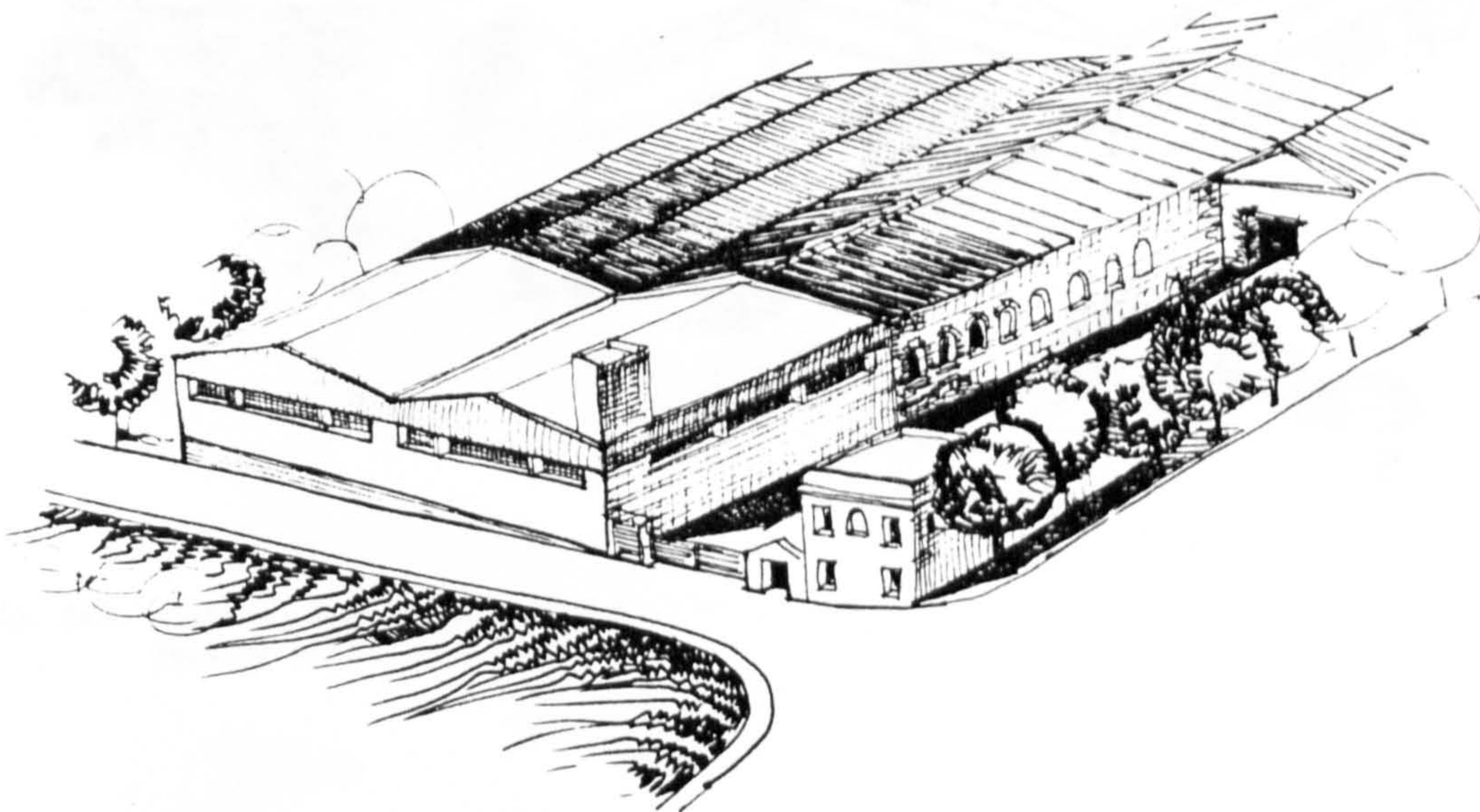


Fig. 239. 'Syros Spinning Mills', (A.21)

Another problematic case is VETLANS NAOUSSA mill in Naoussa (fig. 240). The building has the majority of the characteristics of a *pluralistic building* apart from one: the disciplined articulation of the facades based on consistent principles. Although the mill seems to display the above trait to a great extent, the administration

building has an exceptionally pseudo-vernacular character deriving from a naive imitation of the external surface of a *vernacular building*. Thus, it becomes a kind of dissonant element of the whole cluster. However, traits of the *vernacular building* cannot be attributed to this mill since they are restricted to the office building only.

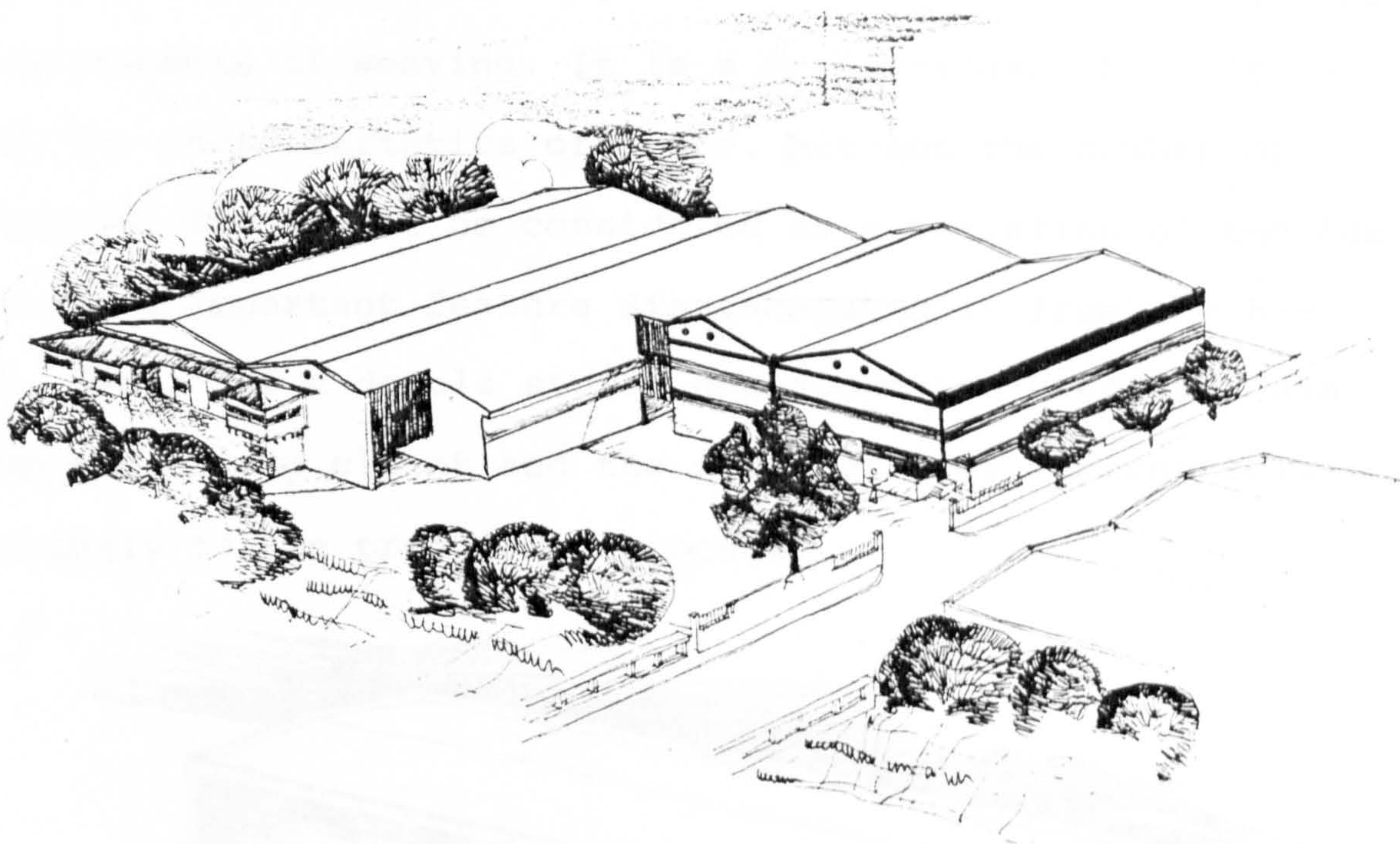


Fig. 240. 'Vetlans Naoussa Spinning & Weaving Mills', (A.52).

The same problem of the complete contrast between the architecture of the production hall and the administration exists in PERFIL mill (A.37). Here, the office building has a pervasive character as regards its volume and its architecture. The architectural treatment of the front building is in dissonance with the production hall which is at the back closely surrounded by other small buildings. It is difficult to attribute this mill to a particular type since the complex is more like an office building than a factory.

Finally, another building should be mentioned which most probably expresses a new trend and may be a new type in weaving industry design. All types described so far are either spinning mills or combine both spinning and weaving activities. Nevertheless, none of them can be attributed particularly either to spinning or weaving industries. There is only one modern building which has been designed for the requirements of weaving. It is a *double-storey box*. It has all the characteristics of a *box*, but not the number of storeys. It can not be considered as a variation of the *box* since an important feature distinguishes it from the *box*. The design of a double storey container has been the main concern of the client and the designer, for reasons related strongly to the production process.

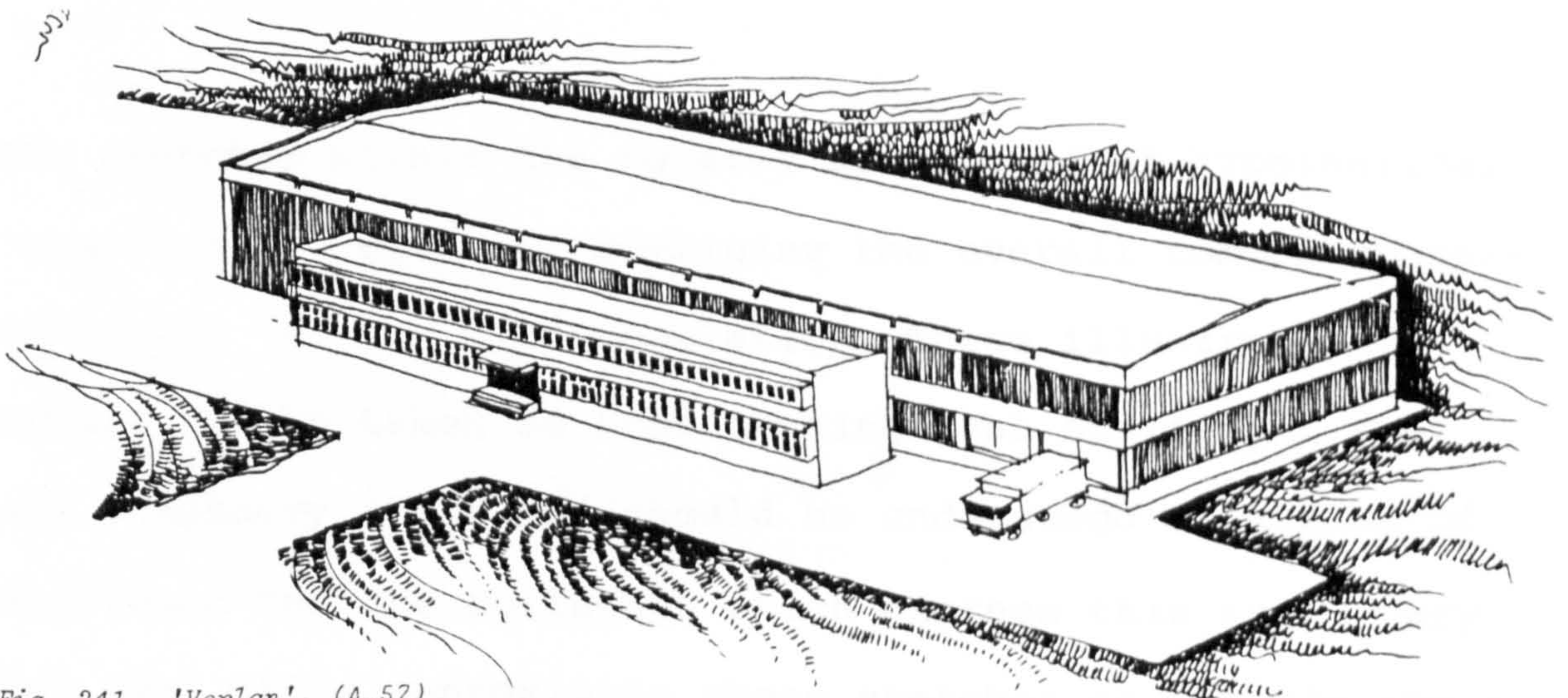


Fig. 241. 'Verlan', (A.57)

5.3. NOTES ON THE EVOLUTION OF TYPES

The buildings of a certain period are not manifestations of a single type but usually appear as concretizations of coexisting types. There is a succession of types and periods of overlapping. The life span of the types I have analysed

is illustrated in the following figure (fig. 242).

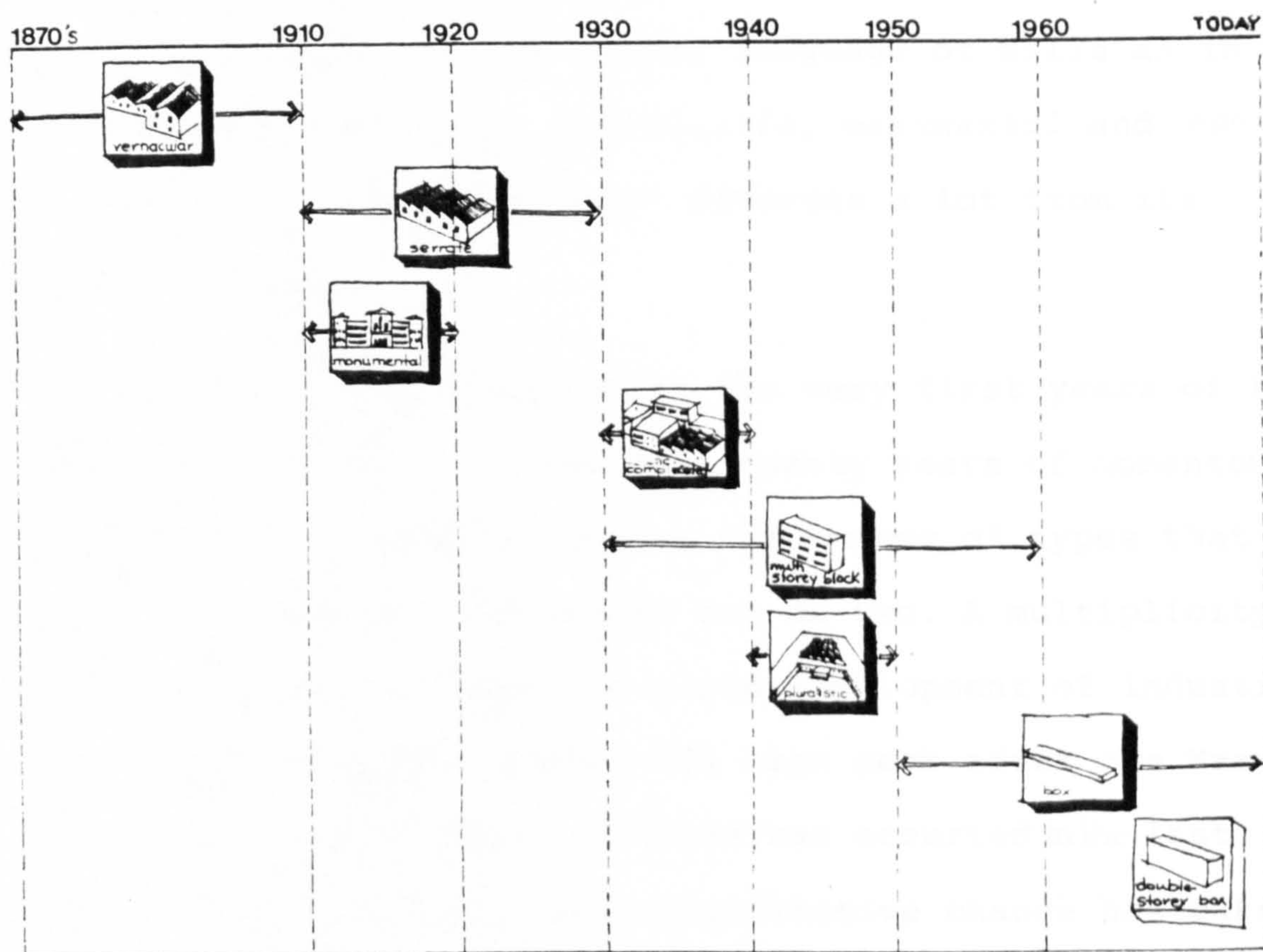


Fig. 242

The sketches within the squares are a kind of hypothetical 'mean-types'⁶ each one combining the overall common characteristics of the type-population. These illustrations should not be taken as representing real buildings. They are imaginary mills and should be understood as a kind of shorthand for the buildings which express this type. Very few real mills approximate these sketches as regards their visual features. The correlation of mean-type and its manifestations depend on the kind of the dominant attribute of the type. If the dominant characteristic refers to certain structural trait of the mills such as the form of the roof (in the case of the *serrate*) or the lack of windows and the shape of the building volume (in the case of the *box*),

then the 'mean-type' approximates its various manifestations. If, in contrast, the dominant feature is related to the general character or the formal language of mills as in the case of the *vernacular*, *pluralistic*, *monumental* and *complicated*, then the 'mean-type' diverges a lot from its manifestations.

It can be observed that during the very first years of the industrialization, and the last twenty years of momentous progress of the textile sector the number of types that have been used are limited to one or two. A multiplicity of form types has followed the rapid development of industry after 1920, and has reached its high peak after the War. A reduction in the number of types has occurred in the last twenty years. In parallel, a quantitative change has taken place concerning the number of the type-population. A shift can be noticed from types with large population to types with small population and finally again to types with large number of manifestations (fig. 243).

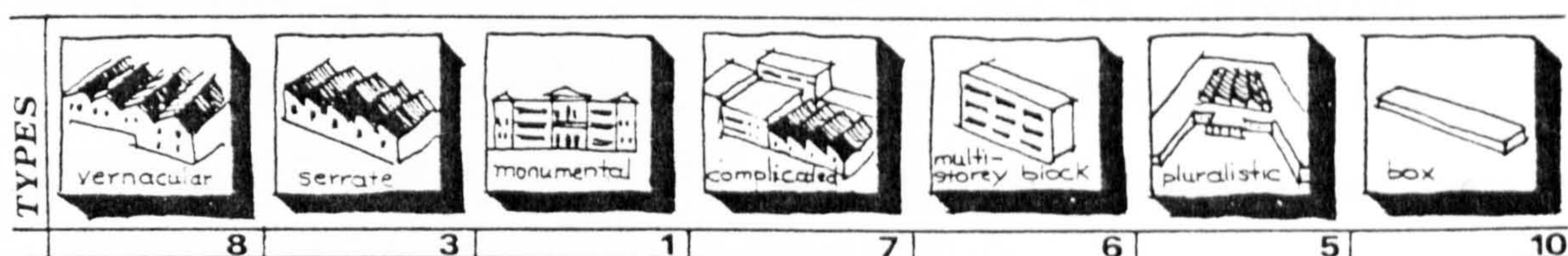


Fig. 243

A gradual shift has occurred from the first types which have been close to traditional houses (*vernacular*) and thus coherent with their surroundings to types which show the industrial spirit of the first era of industrial thriving (*serrate*, *monumental*), then to types representing the

economic crisis (*complicated*), the economic recovery (*block, pluralistic*) and finally to types which express a mechanistic, technological spirit of the flourishing of the textile sector and are separated in terms of location and aesthetics from the residential environment.

In terms of the spatial configuration there is a change from the idea of clusters (*vernacular*) or simple single buildings (*serrate, monumental*), to compact arrangements of volumes (*complicated, pluralistic*), and finally to the idea of single, large and compact building (*block, box*).

The inside-outside relationship has changed a great deal. Early types seek 'open' buildings with orderly articulated openings (*vernacular, serrate, monumental*). The size and form of windows are characterized by variety especially in the *vernacular building* where the traditional environment imposes upon the designer the kind of windows to be used. Gradually, in the following types, the openings become more simple, like continuous strips, extending between the external columns and their height varies providing in certain cases the visual communication between the inner space and the surrounding environment, or functioning in other cases only as a mean of natural lighting. Recent types result in 'closed' buildings where the inside-outside relation does not exist.

The evolution of the form of the roof is interrelated with the evolution of the kind of construction and building materials. The first type (*vernacular*) is a massive con-

struction with wooden or iron columns and pitched or hipped roof. After 1920 reinforced concrete replaces traditional materials and facilitates skeletal constructions with saw tooth roofs (*serrate*) or flat roof slabs in multi-storey buildings (*monumental*, *block*, *pluralistic*). Finally, after 1960 conventional skeletal constructions with reinforced

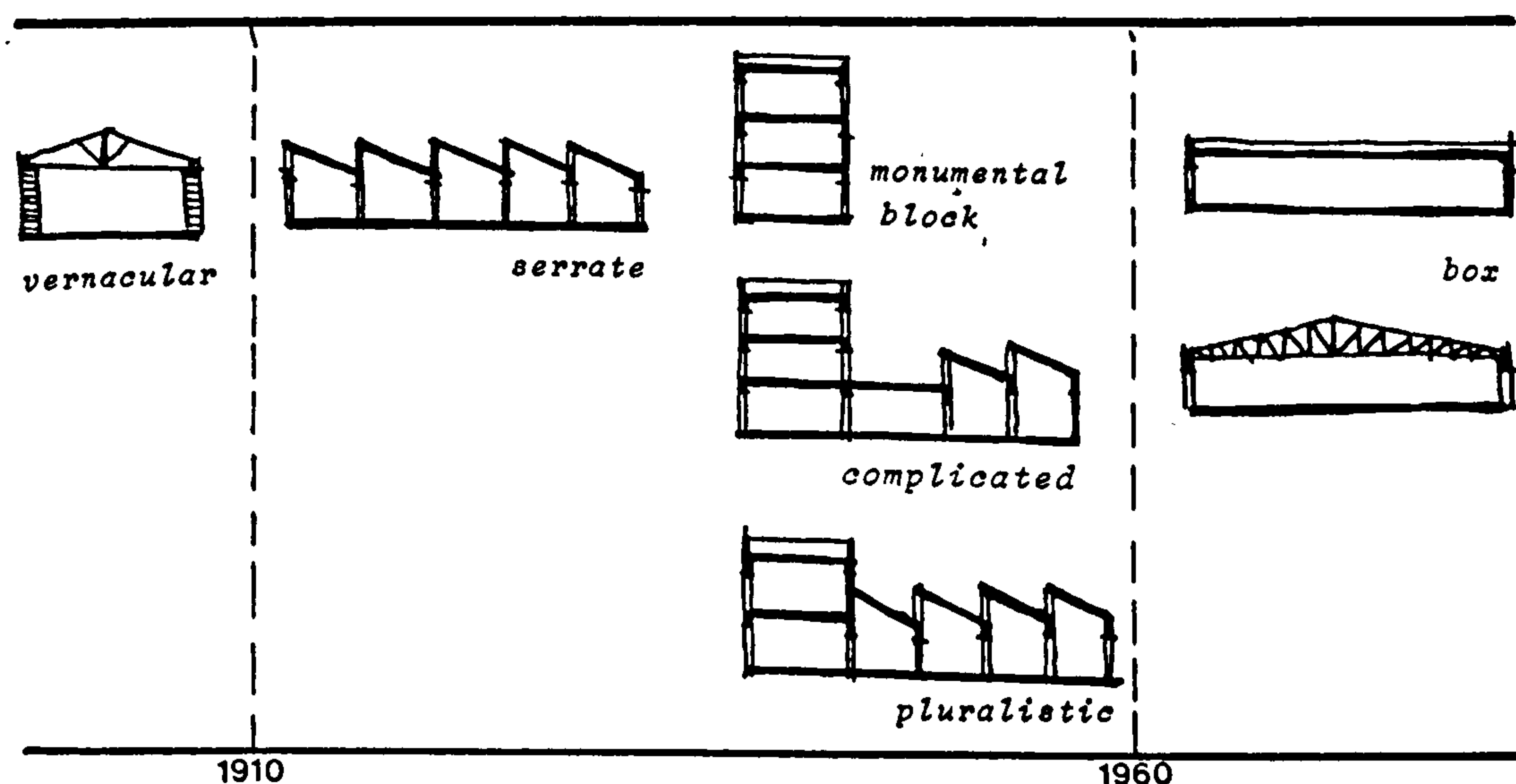


Fig. 244.

concrete and dense column spacing are replaced by reinforced concrete horizontal slabs with inverted beams and finally with prefabricated steel trusses and absence of internal columns.

In terms of the relationship of interior spaces, a gradual development has occurred from simple articulations (linear, in parallel lines, L-shaped) with many partition walls, to complicated articulations emphasized by the existence of many partitions and number of storeys, to rather orderly articulations in zones with few partitions.

Spinning and weaving activities do not seem to have a

particular preference for any type apart from the *double-storey box* which is exclusively developed for the needs of weaving mills. However, when the two activities are combined on one site, the type that is preferred is the *pluralistic* or the composite.

Finally, only the *vernacular*, the *complicated*, the *block* and the *monumental* are limited to particular parts of the country. The first always appears in small traditional towns, the second and third within the tissue of urban centres of Athens and Thessaloniki, whereas the *monumental* exists in Athens only. The remaining types appear to be independent of location.

CHAPTER 6

THE INTERPRETATION OF MILL TYPES

INTRODUCTION

In the previous two chapters, some theoretical aspects were examined of the concept and use of types, and also the notion of type was applied as a taxonomic tool for the survey. The arguments on typology in both the theoretical and descriptive level ran more or less on parallel lines and were interplayed closely.

The first level included a review of the history of architectural thought and referred to scientific fields where taxonomic methods have been developed. The review led to the clarification of the term 'type', and to the distinction between the notions of type and class. The second level of approach, i.e. the descriptive, focused on the identification of types in the sample of the survey. It dealt with the morphological characteristics of the buildings and mainly with those which over a certain period of time appear to be constant.

This work seeks to go beyond the formalistic level of analysis and to reveal the origins of buildings. This chapter seeks to provide an explanation of the mill types, and thus to explicate their origins and meanings. It explores the causes of the emergence of the seven form-types of textile buildings and also their sequential order. To this end it re-reads the types presented in chapter 5 with an interpretive eye based on information concerning the factors that influenced the emergence and development of types.

MILL TYPES AND THEIR ORIGIN

When a new building class emerges in a certain society under the pressure of socioeconomic changes, the first attempts at the formulation of new forms responding to the new needs are based on borrowings and often on arbitrary use of architectural forms of the past and other building classes.

The industrial revolution led to the creation of many new building categories. As W. Curtis stresses "...'

industrialization transformed the very patterns of life and led to the proliferation of new building problems - railway stations, suburban houses, skyscrapers - for which there was no precedent. Thus, the crisis concerning the use of tradition in invention was exacerbated by the creation of novel types with no certain pedigree. Moreover, mechanization disrupted the world of crafts and hastened the collapse of vernacular traditions"¹. Nevertheless,

during the first years of these transformations and in areas which did not belong to the sphere of interests of architects - as for instance the design of industrial building - architectural forms emerged from the rich tradition of the construction of houses.

The creation of industry's own architectural language was the result of a slow process. The nature, the duration and the completion of this process were different in many countries since they were motivated by a complex of factors which were variously knitted together, such as the socioeconomic conditions, cultural attributes, legislation, means and methods of construction and the development of architecture.

During the preparatory years of its industrial revolution

Greece witnessed the emergence of only one industrial building type; the *vernacular*. In Britain, however, in the first years of industrialization, the architectural forms of the industrial buildings were, according to H. A. N. Brockman², manifestations of three trends. The first two can be characterized as the vernacular (fig.245) and the sophisticated (fig.246), whereas the third to which the civil engineers were more inclined, was basically steeped in the Georgian style (fig.247). The first two trends were based on classical precedent. The vernacular derived mainly from earlier masonry practice, whereas the sophisticated showed how clear classical principles can be interpreted and merged into industrial building design.

There was a difference in the duration of this transitory period between the two countries. In Greece it was considerably less than in Britain because the process of its industrialization took place when the majority of European countries were already experiencing their second technological revolution⁶.

The first type of textile buildings in Greece - the *vernacular* - was the only one that was manifested throughout the country during the period of the thirty years around the turn of the century. It was an era when the industrial buildings were in the hands of the traditional master builders, who in order to satisfy the requirements of the new building class, had to rely on and copy the same methods, materials and formal language they used to build the houses, and warehouses. Their experience in

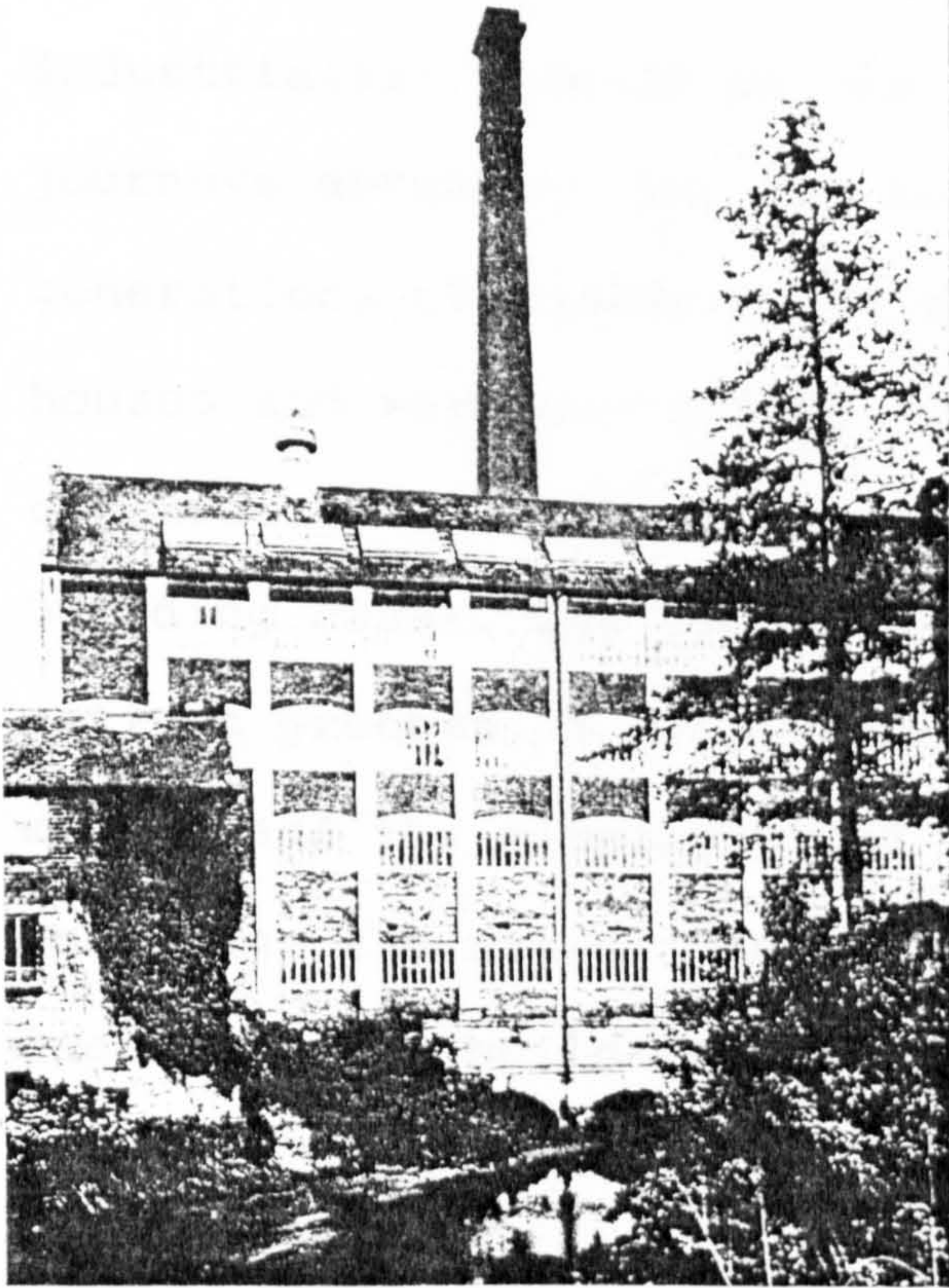


Fig. 245. Stanley Mill at Stonehouse, 1813³

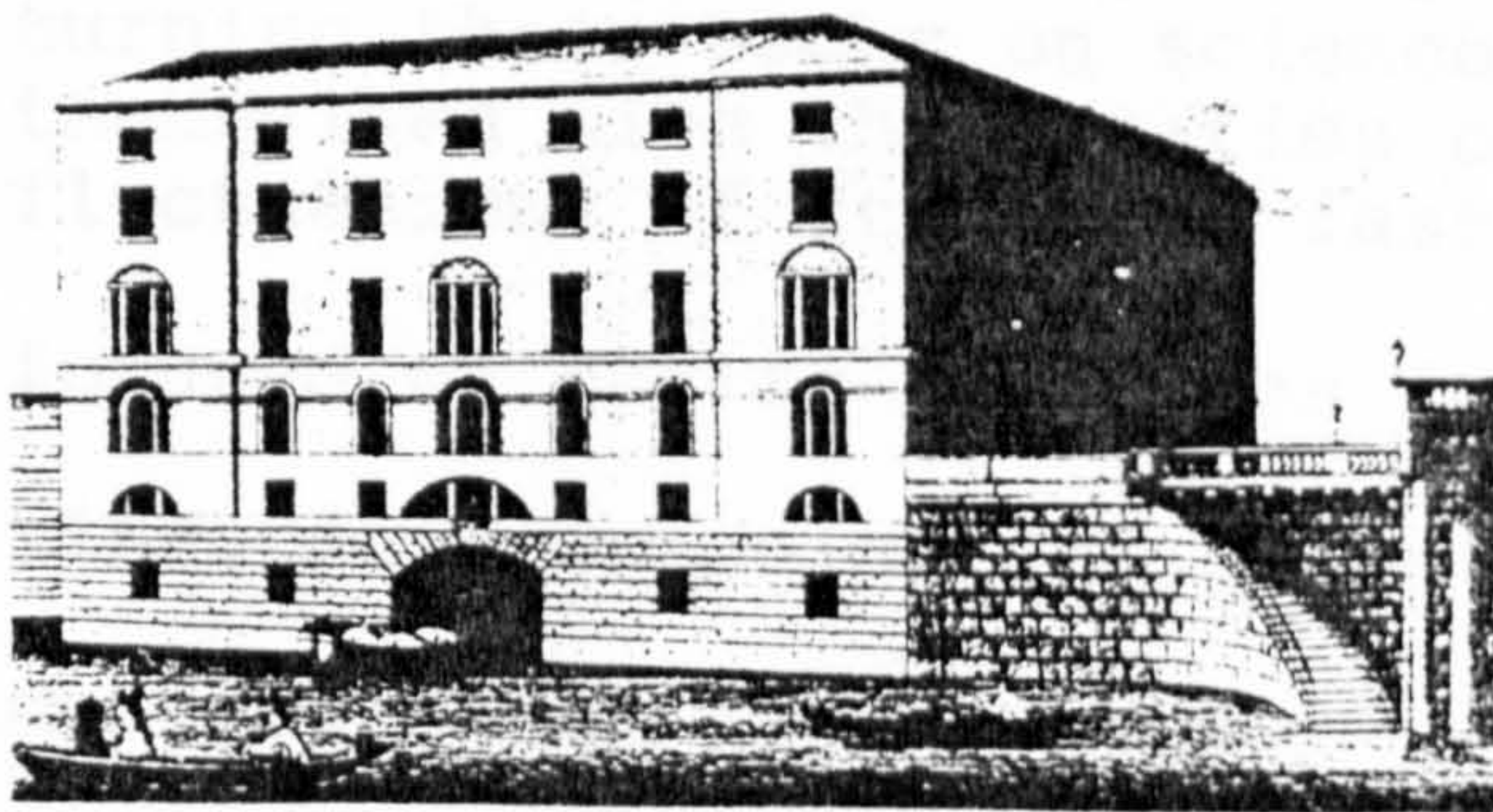


Fig. 246. Albion Mills, Southwark, 1786⁴



Fig. 247. Cressbrook Mill, Derbyshire, 1837⁵

the construction of traditional houses was fused with the industrialist's image of the factory as formed by his journeys abroad to buy the machinery. The knowledge of generations of builders gained from erecting traditional houses and warehouses (fig.248 and fig.249) entered into the construction of the factories (fig.250) of the new emerging building class. The small scale of the early factories, their artisan process of production without any specialized requirements, and the simplicity of construction did not at all encourage the use of the architect or even the structural engineer. The builders were the appropriate persons who offered 'design and build' services at a lower price.

The architects, in their turn, were not interested in getting involved in the design of factories. In a similar way to the British architects of the Industrial Revolution they "were turning their backs on science and increasingly preoccupying themselves with the niceties of scholarship and the fluctuations of stylistic fashion"⁸. Their interests were focused on public buildings (temples, university buildings, libraries, schools) and private houses of the rich, mainly merchants and land owners.

No architectural school existed in Greece, the first department of architecture being established in Athens in 1917. However, the provision of knowledge of architectural composition, architectural history, and history of art was part of the curriculum of civil engineers⁹. In practice those who designed the majority of significant public and private buildings were foreign architects - mainly Germans, Danes and a few Italians¹⁰ -, or Greeks educated in the



Fig. 248. An old warehouse in the city of Xanthi, 1860's⁷



Fig. 249. An old warehouse in the city of Volos



Fig. 250. Naoussa Spinning Mills', (A.9), (Naoussa)

École des Beaux Arts, and Germany.

The majority embodied the principles of German Neoclassicism¹¹ which had fundamental influence on all spheres of the social and cultural life of Greece from the early years of independence until the beginning of the twentieth century. As G. Tsarouchis - a modern Greek artist - has pointed out "...

German Neoclassicism in architecture, the child of the great Palladio, combines two great qualities that fulfilled two great needs of the nineteenth century Greeks ...1. to become Europeans, 2. to return to the purity of ancient Greece. Which satanic contrivance could better quench fully this double thirst of the Greeks as much as the Bavarian Neoclassicism ... Neoclassicism lasted as long as the national enthusiasm and the illusions of liberty"¹².

During the first two decades of the twentieth century the German Neoclassicism coexisted with some other eclectic trends. The architecture of those years was restricted according to K. Biris, "sometimes to the repetition of forms that were published in periodicals of the countries of the north with the features of poverty and aridity, with no elegance in expression and sometimes, even worse, on an improvisation of a decorative expression with very bad taste"¹³.

In the professional field, in parallel with the architectural élite, was a core of engineers who addressed their architectural skills to the middle class to satisfy its needs for small houses. The typical popular neoclassical house, so widely spread in many urban centres in Greece was the result of their architectural contribution. They managed to couple satisfactorily "the neoclassical principles with a spontaneous popular sensibility"¹⁴. Civil engineers in general practiced architectural and structural design and like the architects, were not interested in designing factories.

However, the *monumental building*, though not often used in

mills, was the product of the limited involvement of the architects in factory design. They satisfied the client's desire for an impressive building which could express the image of a prosperous firm, as well as meet its functional and economic needs.

This type had emerged long before in other European countries and was created with conscious reference to styles of the past. It was an era when according to H. Muthesius "*man diese Häßlichkeit beseitigen zu müssen glaubte, wurde der Architect herangeholt, um eine Art Maskierung vorzunehmen*"¹⁵ ["it was believed that one had to remove that ugliness (of the constructions of engineers), and the architects to undertake the artistic camouflage"]. To achieve this, architects had to refer to known formal vocabularies and follow eclectic processes as they did for other building classes.

Later on, at the beginning of the twentieth century the *monumental building* continued to exist but by then industrial architecture was considered as monumental art. Peter Behrens, the main supporter of this idea, believed that the principles of classical architecture were the only means through which monumentality could be manifested in industrial building design. H. Müller criticizing Behrens' concept of monumentality wrote that with monumentality "*... Behrens einerseits die Kultivierung der Gegenwart von der Industrie erwartete. Andererseits, galt für Behrens klassizistische Formalität als überindividueller Ausdruck von Kultiviertheit überhaupt*"¹⁶ [".. on the one hand Behrens expected the cultural refinement of the present situation of industry; on the other hand Behrens considered classical formality to be the supra-individual expression of cultural refinement per se"]. X

Thus, the *monumental building* originated from the involvement of architects in industry and the fusion of art with technology. The aim was that the building should express

the image of a flourishing firm whose owner's prosperity and prestige as 'builders' of the new era should be maintained. The manifestations of this type were based on two different concepts of architecture: architecture as a decorative art and architecture as a monumental art. The former idea was reflected in industrial buildings of the nineteenth century and occasionally of the twentieth century whose external surface was designed as a kind of mask with renaissance, baroque or neoclassical vocabulary either fragmented or not (fig.251,252,253). The latter concept was expressed in the industrial buildings of the first years of the twentieth century (fig.254,255) - the formative years of the modern movement - and advocated mainly by P. Behrens.

Behrens' formal objectives and his idea of monumentality served a double purpose according to T. Buddensieg and H.

Rogge: "the pure mathematical calculation of the engineer must be translated into architecture which acts upon the senses without renouncing modern building materials such as glass, steel and concrete; it was necessary however, to give these materials produced on an architectural scale, the spatial quality of classical architecture while giving up the ornamental effect of the latter and the historical grammar of its orders, retaining only the proportional organization and the rhythm of the structure"²².

This reference to the principles of classical architecture and not to its formal vocabulary, and further more the fusion of abstracted classical vocabulary - i.e. without literal imitation - with skeletal concrete construction, are the characteristics of the monumental building in Greek textile mills. The fact that only two examples²³ of this type were built is because its high cost meant that only few firms



Fig. 251. Carpet factory, Glasgow, 1898 by W. Leiper 17

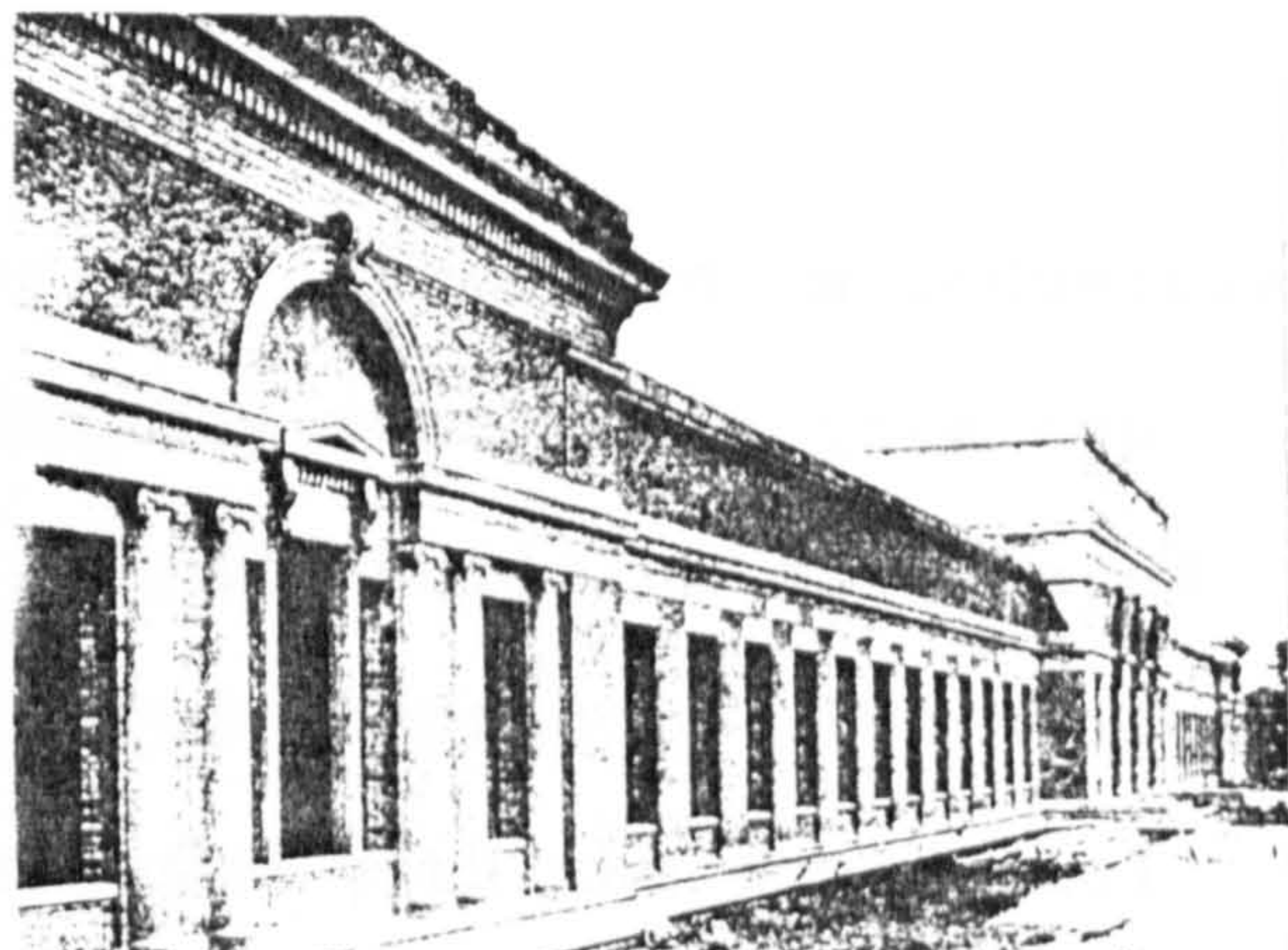


Fig. 252. Factory, Baldock, 1925, by T.H.F. Burditt 18

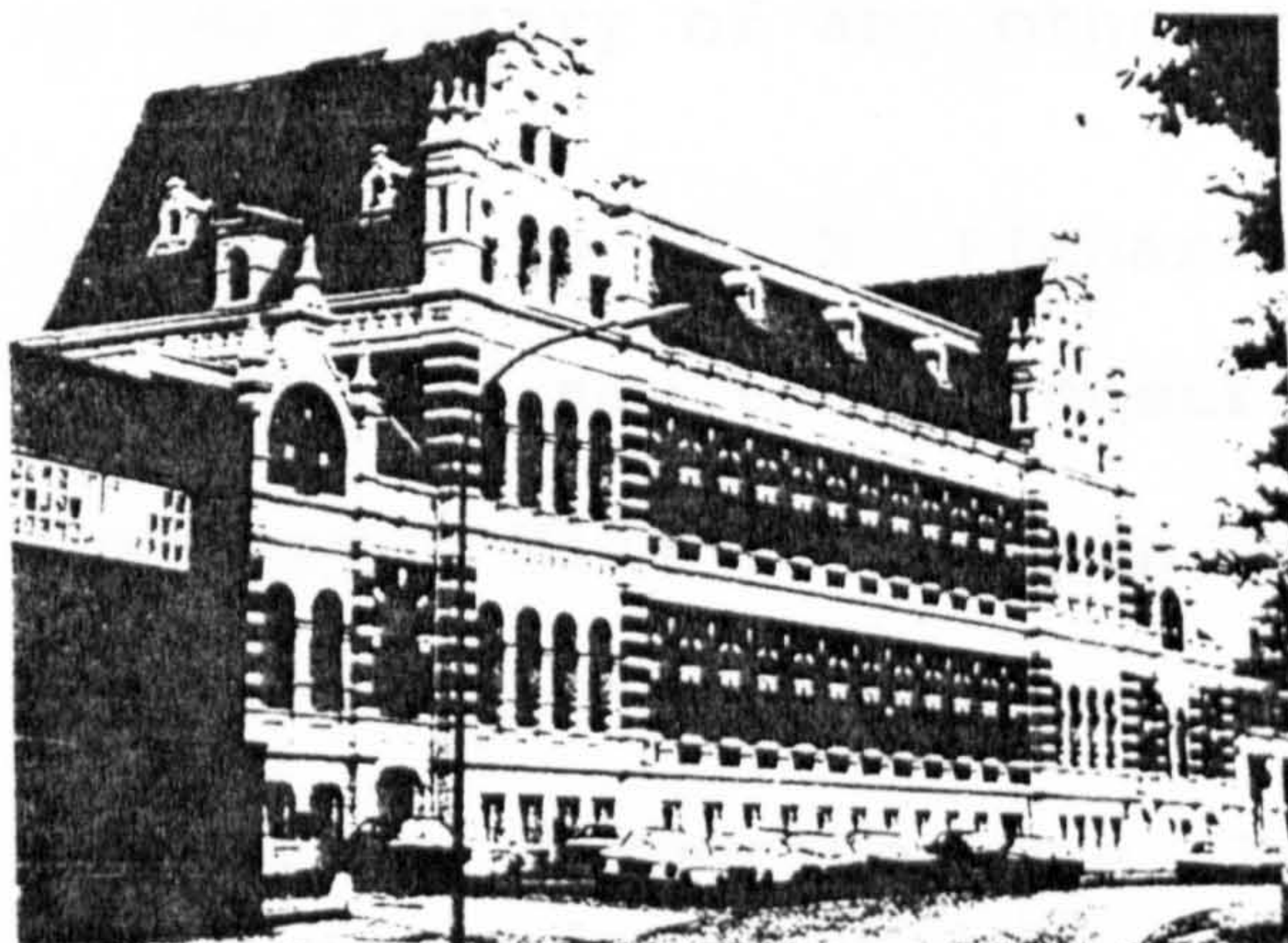
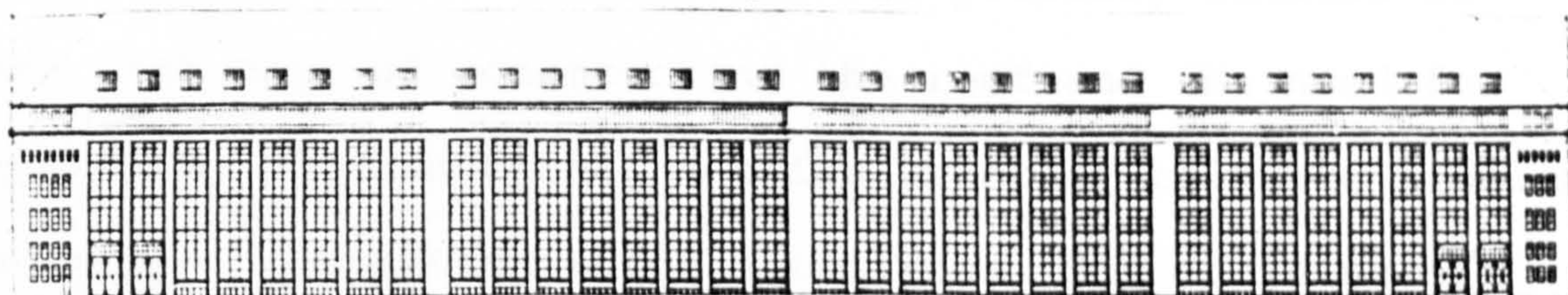


Fig. 253. Textile Factory, Gebr. Laurenz in Ochtrup, 1893, by Beltmann 19



Fig. 254. Silkmill, Michels & Cie, Berlin, 1913 by H. Muthesius 20



Stangford



Stangford



MA 180

Fig. 255. A motor factory designed by P. Behrens in 1909 21

could afford it.

After 1910 the *serrate building* was introduced in industrial building design. One can justifiably state that this type was imported from abroad. The serrate building originated in Europe out of the need for large shopfloors with uniform illumination. These motivations fused with the commercial development of steel and reinforced concrete frames led to the emergence of this type which did not have any precedent in the history of any other building class.

According to J. M. Richards one of the earliest versions of saw tooth constructions was an addition to Cressbrook Mill in Britain (fig. 256), built in the second half of the nineteenth century. However, the *serrate mill* became the favourite type later at the very end of the nineteenth century (fig. 257, 258). In Greece the *serrate building* was applied in the textile mills for a relatively short period (1911-1935). This was probably because of the high cost of constructing the roof and the need for elaborate constructional details in order to avoid problems of water penetration through the roof. The building of the IFANET spinning and weaving industry (A. 7) which was constructed in 1911 can be considered as the first *serrate mill*. At that time the owner was a Turkish company²⁷ and the design of the building was imported from Europe together with the machines. Later on after the 1920's civil engineers started becoming involved in factory design due to legislative changes, and grasped the principles of the *serrate building*, and applied it in other parts of the country.



Fig. 256. Cressbrook Mill, Derbyshire,
1837 ²⁴

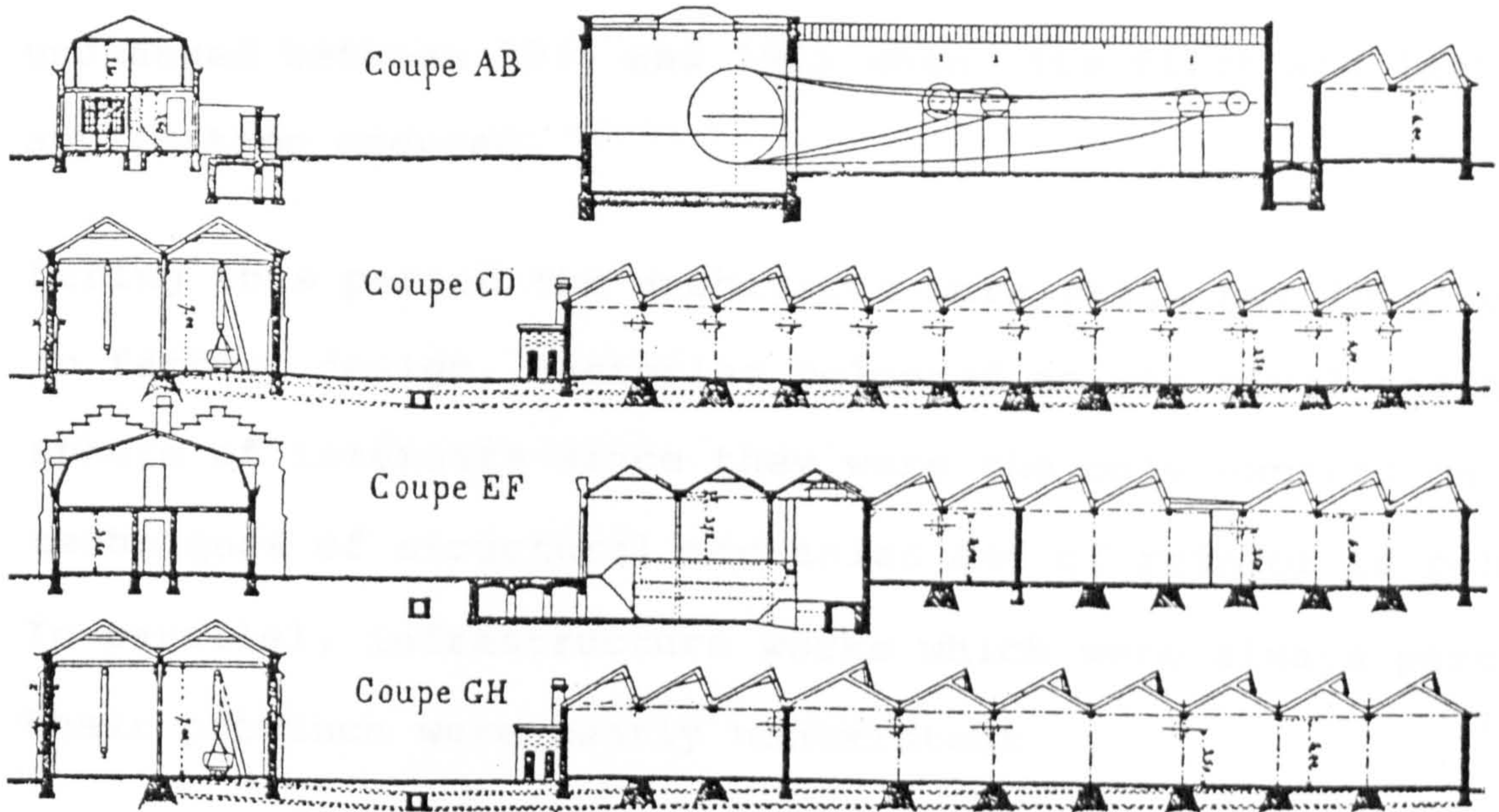


Fig. 257. Mill of M.S.Walker & Cie, Lille, Architects M.M.Sée ²⁵

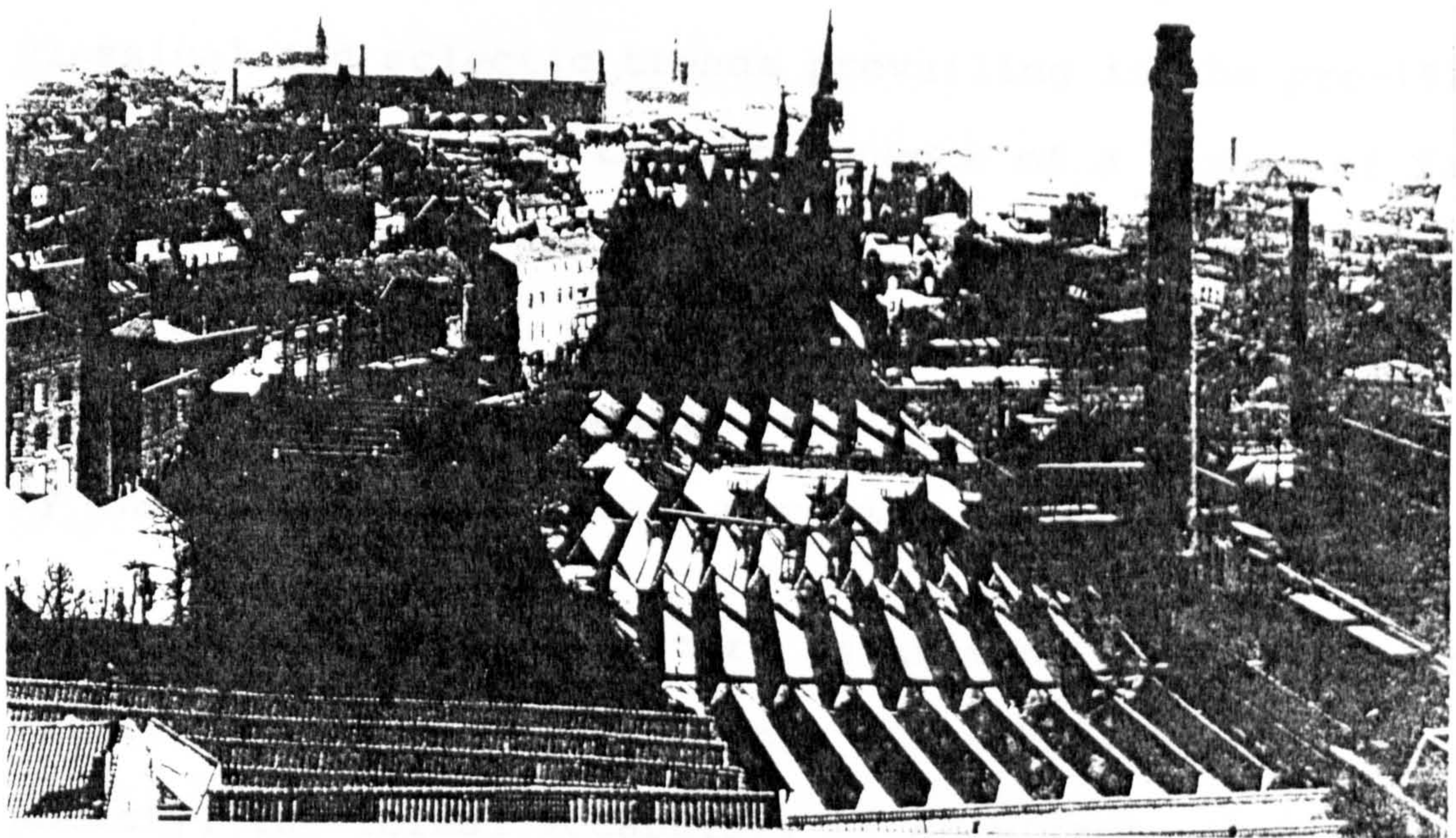


Fig.258. View of the centre of Roubaix, Lille, France, about 1900 ²⁶

At the same period reinforced concrete which had already been applied in other constructions, entered into the area of mill design and facilitated the popularization of the *serrate building*. Despite the fact that the use of reinforced concrete enabled some variations in the form of the already imported type, as for instance changes in the shape of openings, the formal language of the serrate mill remained unchanged between 1911 and 1935 when its first and last application occurred.

During this period the architects were still not involved in factory design. Factories belonged to the civil engineers' sphere of interests since they were the only experts on the techniques of structural mechanics and of reinforced concrete. In parallel, infrastructure works which were always part of their province were nearly nonexistent

The architects' attitude towards social problems in general and design choices in particular turned away from the neo-classical and eclectic trends prevailing in the pre-1920's period. The shift was the consequence of a number of factors: the general social and political fermentation of the era which brought forth new needs, the stage of decadence Greek architecture²⁸ had reached after nearly 100 years, and finally the bloom of the modern movement in Western Europe.

In the School of Architecture in Athens, architects were mainly concerned about the role of architecture in Greek society, the formal vocabulary of architects, and the policy of the architectural school. Answers to these core

problems came from two diverse trends that can be considered as the opposition between regional and international architecture. Regional architecture meant the fusion and reconciliation of the principles of the modern movement with indigenous architectural characteristics. This problem became the centre of the architectural debate of the inter-War period, and was expressed clearly in a written duel which occurred between two groups of architects, in the magazine of the Technical Chamber of Greece, the 'Technica Chronica'²⁹

The architects B. Kassandras and K. Biris criticized the application of the principles of the modern movement to Greek architecture, and also the idea of transferring these principles without taking into consideration the particularities of the Greek domain. B. Kassandras argued in his article 'Thoughts about modern architectural trends', about the relationship between modernism and tradition. He wrote "modernism in architecture should be subordinated to tradition but should not be its slave. Tradition is a neverending source of condensed wisdom; it does not mean imitation or triviality. Tradition is the principles which are imposed by the spirit, the climate, the social and living conditions of a certain place. Classicism is tradition. Classicism is not meant as the conservation of a stereotype element e.g. corinthian or ionic capitals. It means: rationalist and harmonious use of matter and form"³⁰. K.

Biris concentrated more on specific characteristics of the traditional Greek buildings - i.e. the small windows, the pitched roof, stone, wood and marble as building materials - which had been abandoned due to the introduction of modern formal language advocated by the modernists. P. Karantinos attacked both Kassandras and Biris but concentrated more on

the views of the latter. Five years later K. Kitsikis answered the question which he claimed was the burning one:

"Why don't we have a modern Greek architecture?". "We do not have and we will not acquire Greek architecture ... Architecture today is international ... because a long time ago an identification took place between concepts of life and aesthetic views mainly because nowadays distance has been abolished"³¹. Although the issue of the relationship between modernism and tradition preoccupied the minds of the academia, the majority of Greek architects in practice had been educated in Greece or abroad and were deeply influenced by the values and ideas of the Modern movement of Western Europe³².

An echo of some of the rationalist principles, which have been interpreted and applied by civil engineers in factory design, can be noticed in the first appearance of the *complicated building*. This type is the product of the economic crisis, of financial restrictions and of the limitation of the site. The treatment of the facades shows a superficial application of the modern formal vocabulary (plain unembellished volumes with sharp ends interrupted by long strips of windows), and is not accompanied by similar principles in the articulation of spaces which is irrational and complicated.

This type can rarely be found in magazines and books since it does not appear as a successful example to be published and criticized. Its lack of architectural quality or social significance and its strict devotion to merely functional needs and to budget restrictions, led to buildings, which, undoubtedly, were formally impoverished. This type

lasted as long as the problems of the economic crisis did, and the attitude of industrialists to consider their factory as merely an envelope to enclose the machinery without taking into account issues of environmental conditions, provisions for the workers, and the aesthetic coherence of their building with the surrounding architectural environment.

The *multi-storey block* which also appeared before the Second World War reflects modern principles more clearly and in a consistent way. It is basically the product of site restrictions and of the more conscious understanding of the modern architectural language by the designers. The simple and regular composition of the facades is coupled with a rational organization of the spaces and an open production hall which allows flexibility in the arrangement of the machinery. Due to its neutral character this type has also been used for other kinds of production processes, as for instance in the tobacco industry (fig. 259, 260).

The *pluralistic building* appeared at the end of the '40's, and coincided with the period of reconstruction of the country from the War damages and the extraordinary boom of the construction industry. That tremendous increase in construction activity had a fundamental impact on architecture, the role of architects and engineers, and also on architectural education.

During this period the engineer's role underwent a radical change as it shifted from the area of the designer to the area of the contractor. The boom in the construction industry



Fig. 259 .Tobacco Industry. of Papastratos, 1930's, Piraeus



Fig. 260. Tobacco Industry of Papastratos, 1930's, Piraeus

and a number of statutory measures³³ led to this change and broadened the architects' area of professional action.

Under these conditions in construction activity factories were eminently the buildings civil engineers were still more concerned about. Their interest was from the point of view of designer , consultant, inspector, surveyor and contractor too. From that period onwards architects gradually started being commissioned by wealthy industrialists to design their industrial premises. It is worth noting that the architectural magazine of those years 'Architektoniki' published the first factories designed by architects. The gradual involvement of architects in the design of industrial buildings was conditioned by a particular change in the attitude of the clients. Industrialists, and especially those who owned large firms, were beginning to realize that apart from well produced and promoted products, the strict conditions of the competitive market required a building designed to shelter the production activity with flexibility to adapt to future changes and needs, and aesthetically impressive so as to promote through its architectural form the image of a prosperous firm. Furthermore, it was the increasing complexity of the buildings that favoured the architect and caused his abilities to be esteemed.

Although the industrial market started to demand the architects' contribution, at the academic level the design of industrial buildings was considered as a tiresome and unimportant matter and in any case it was part of the curriculum of the School of Engineering. We can read in the

'Guide of Studies' of the academic year 1950-51 that the topic 'Labour and Factory Organization' was offered to civil and mechanical engineers and covered a wide range of issues such as the location on the site, the choice of the proper machines and their arrangement and foundation, the transportation system, the organization of the administration and warehouses, the labour organization, the estimation of the cost, the articulation of spaces and buildings, lighting, heating, ventilation and drainage³⁴. It is apparent that the educational system prepared the engineers to deal with the overall organization and design of factories and ignored the architects' potential contribution.

At the same time, the main orientation of the Department of Architecture of the Technical University of Athens was towards the creation of an artistic atmosphere. This trend coupled with the limited number of students³⁵ resulted in the creation of a tightly knit social group. The two opposed lines of thought of the previous period regarding to the appropriate kind of modern Greek architecture appeared again in the post-War years and gave the tone to the ideological debate: modern versus regional architecture³⁶.

Within this climate the *pluralistic building* appeared as the product of the increasing realization of the industrialists that the form of their building should not be derived completely from functional considerations, related to the process of manufacturing, but above all they should have an expressive presence and meet with the needs of all the occupants. Furthermore, the *pluralistic building* was the

result of the gradual involvement of architects in industrial building design and of their familiarization and espousal with the ideas of modern movement; but with more concern for its formal vocabulary and less for its general principles.

The *pluralistic building* was based on a simple modern formal language, which was used in a variety of ways to signify the different functions, and on the use of a restricted variety of building materials. But, above all, this type did not originate from any theoretical ideas, at least none that were explicitly stated, concerning industrial building design, the relationship of industry and art, or the relationship between architecture, workplace and workers. This condition was due to the nature of the architect's education and the lack of any theoretical debate on these issues at the academic level.

This fact distinguishes this type from other types, based on the modern vocabulary, which were developed in Europe at the beginning of the century - through the ideas of Expressionists and Constructivists - or later, after the War, in factory design practice in Britain, Germany and the U.S.A.³⁷ However, this type echoes Walter Gropius' early claim about the guiding principles in industrial building architecture:

*'exakt geprägte Form ..., klare Kontraste, Ordnen der Glieder, Reihung gleicher Teile und Einheit von Form und Farbe werden entsprechend der Energie und Ökonomie unseres öffentlichen Lebens das ästhetische Rüstzeug des modernen Baukünstlers werden'*³⁸ ["exact characteristic form ... clear contrasts, the ordering of members, the sequence of the components, and the unity of form and colour should correspond to the energy and economics of our public life and become the aesthetic tools of modern designers"] This type

was also affected by two factors. The first was the provision of a flexible open space for optimizing production layout and material flow, and the second the high speed of erection of the building with low cost.

The *pluralistic building* survived as a pure type until the middle 60's when the rapid increase in the number of textile firms was accompanied by the importation of new spinning and weaving machines and the attempts to provide a physically controlled environment which was necessary for the proper functioning of the machinery and the quality of the products.

During this period a second construction boom occurred, which conditioned the introduction of new building materials. In parallel, changes took place in the architectural arena. The continuous overlapping of the roles of architects and engineers eventually was broken, though the latter were still commissioned to design small private houses and a few high rise residential blocks. It was the public attitude which changed in favour of the architect, who was considered as the appropriate professional to design an aesthetically acceptable facade and to cope with the articulation of the inner spaces. It is worth mentioning that the architect has a fairly good knowledge of the implications of concrete construction due to his education, and is legally permitted to make the structural calculations of small buildings. The engineer, however, takes only an elementary course on architectural design during the first years of his studies.

At the academic level drastic changes occurred with the establishment of a new Department of Architecture in the School of Technology of the Aristotle University of Thessaloniki (1957). In the new Department the character and context of architectural teaching³⁹ shifted from a 'scientific'⁴⁰ to a 'sociological' approach in the end of the 60's and finally to theoretical issues coupled with professional efficiency. The Department of Architecture of the Technical University of Athens did not experience all these transformations and remained more design orientated.

After 1970 factory design became a formal part of the curriculum only in the Department of Architecture of the University of Thessaloniki. This was probably due more to the personal interest of the professors, who offered the topic, than to a pressing need in the market which did not seem to have any influential effect on the kind of education provided by the universities. The design exercises on factories were accompanied by a number of lectures⁴¹ covering a wide range of issues such as the historical evolution of industrial labour and architecture, the relationship of industry with society, the organizational aspects of industry, the industry at the urban level, the problems of designing a factory, the architectural composition, structure, details, the requirements of various spaces, and finally the environmental conditions.

At the same time with these post-60's transformations the *box* emerged in mill design. The *box* as a type was generated in the early 50's in the U.S.A. and only after the 60's in Europe. The need to control the quality of the environmental

conditions using air-conditioning systems primarily for the production process and secondarily for the workers, was the main impetus behind this type. Additionally, there was the need for wide spans and a production hall free from columns for the oblong machines, having various expansion possibilities and being in direct relationship with the administration, the workers' facilities and the installations. The *box*, whose main characteristics are the oblong shape, the lack of windows, the variety of building materials, the prefabricated roof, and the machine aesthetic, found a broad response in Greece, probably for reasons concerning the speed of erection and the simple and relatively low cost of construction. However, in other European countries this did not seem to be, so much the favourite type. This fact is revealed from the examples published in books and special issues of magazines⁴² on industrial architecture; only eight buildings which belong to this type are distinguished. It seems probable, that a suitable type has been found to respond completely to the current needs of textile firms in Greece, and there is no need for any change. It is very difficult to foresee whether the present economic crisis of the sector will cause the discarding of this type and the emergence of a new one.

The *double-storey box* which recently appeared in the weaving industries, arose out of the same factors as the *box* and the additional fact that the production process of weaving fabrics will proceed more quickly and smoothly if it takes place in a double-storey production hall with continuous

interrelationship between the two levels. It is doubtful whether the *double-storey box* is the favoured type for weaving mills because of the problems of strong vibrations caused by the high speeds of the weaving machines which are placed on the second floor. Considering the fact that the development of the technology of weaving machines is not orientated towards the elimination of their vibrating motions but more of their excessive sound, the re-manifestation of this type should be related to the construction of a strong and expressive structural skeleton.

Finally, the *composite* type has the largest life span of all the other types. The reason lies in the fact that the *composite* type, by definition, is not a pure type, but is always based on different combinations of other types mainly those which are dominant in a particular period. There are only two characteristics of the *composite* type which remain constant, irrespective of the number of types involved in the composition. Firstly, the *composite* type is always built on sites with no restrictions. Secondly, it always embodies a particular feature of the *pluralistic building* which is the use of a common formal language expressed in variations to distinguish the functionally different parts of the buildings.

CHAPTER 7

A DISCUSSION OF THEORETICAL ISSUES INVOLVED IN THE TYPOLOGICAL APPROACH

INTRODUCTION

The notion of type has been used throughout the thesis as a descriptive tool for the historical analysis of a particular building class. The main reason for the choice of this approach is an endeavour to focus on the buildings and not on architects or styles. A central consideration has been the study of the evolution of the built environment, in terms of forms and ideas, should embrace the whole range of buildings not only those selected for their supposed architectural importance.

This chapter discusses some important issues concerning the use of types in the description of mills, and in architecture in general, in terms of the value of a theory of types. It focuses on some key issues which arise from the survey and are related to the nature of type as a taxonomic tool in historical description. For this purpose, some of the views presented in chapter 4 are reintroduced and criticized in the light of the conclusions of the case study. More analytically the points which are discussed refer to the relationship between building class and form type, the potentiality and justification of the use of types in historical description, the conditions of the emergence, evolution, coexistence, succession and death of types, and the 'biological fallacy' associated with the notion of type in architecture.

Thus, this chapter concentrates upon how the application of types to mill buildings has illuminated those issues which have been raised earlier in general terms.

Finally, a discussion is opened on the potential use of types in the design of buildings, by raising the problems which are embodied in such an attempt, and by emphasizing the theoretical premises on which it should be based.

An important problem involved in the typological approach is the relationship between the concept of 'form type' and 'building class'. Their different meanings have already been explained on the basis of the relation of typology and classification (chapter 4). Their causal connection has also been discussed in general terms when the notion of type and its application were raised. Although it is clear from the typological analysis of the present work that there are many different types of buildings which share a common function, it is very difficult to find common types for a wide range of building classes unless we are dealing with buildings which are functionally analogous and have similar spatial requirements. For instance, a *box* can equally be a factory, a supermarket, a laboratory or a warehouse. A *multi-storey block* can also be a type for an office building or warehouse. This characteristic of the type does not imply that similarities between building classes cannot exist. On the contrary, there are many but they are not combined to a type since they refer to fragments of the buildings. These fragments are mainly the formal language, (fig. 261, 262) characteristic motifs such as particular kinds of windows, porticos, roofs etc, and very rarely the articulation of inner spaces which obviously is closely related to the functional requirements of the buildings. These similarities between building classes usually occur in two cases. When buildings are of the same style (fig. 263, 264), and when they have the impress of the same architect (fig. 265, 266).



Fig. 261. American Embassy in Athens, 1961, by W.Gropius²

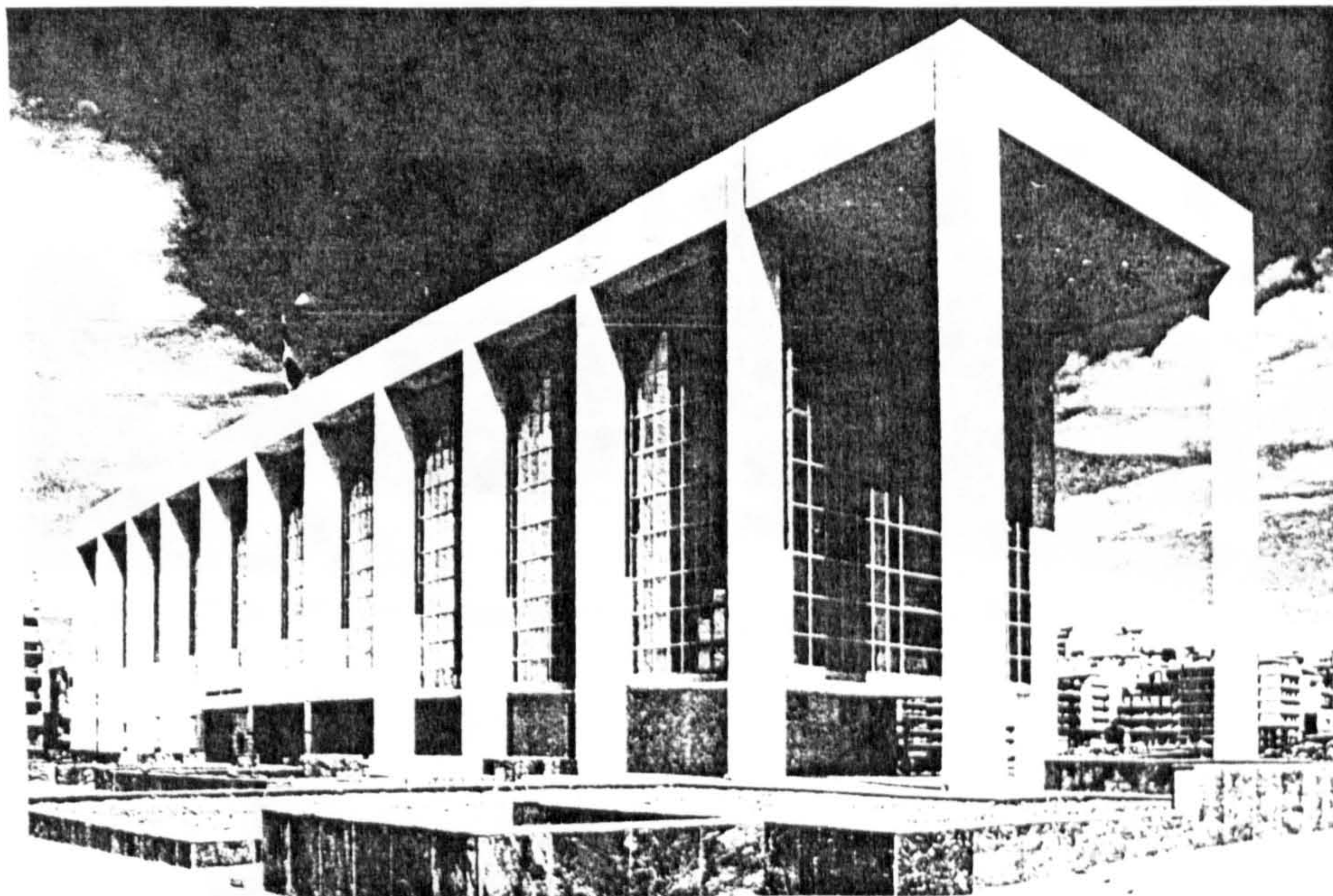


Fig. 262. Court of Justice, Athens, 1980, by I. RIZOS and D. KANTAROPOULOS³

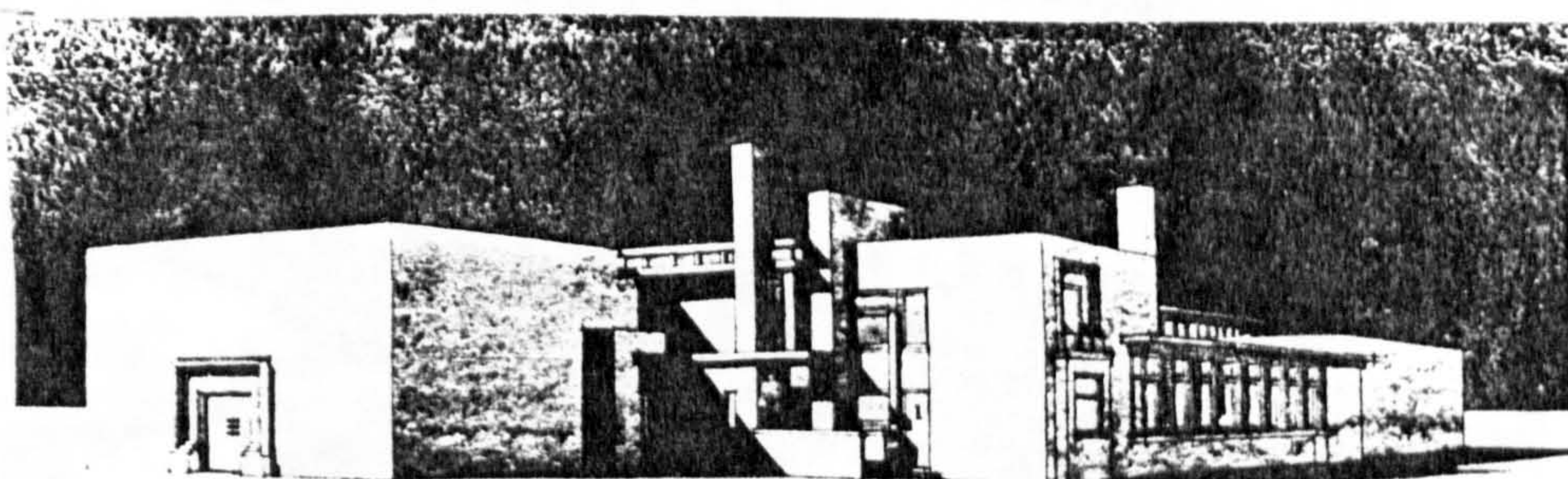


Fig. 263. Project for a factory, 1919, by J.P.Oud⁴

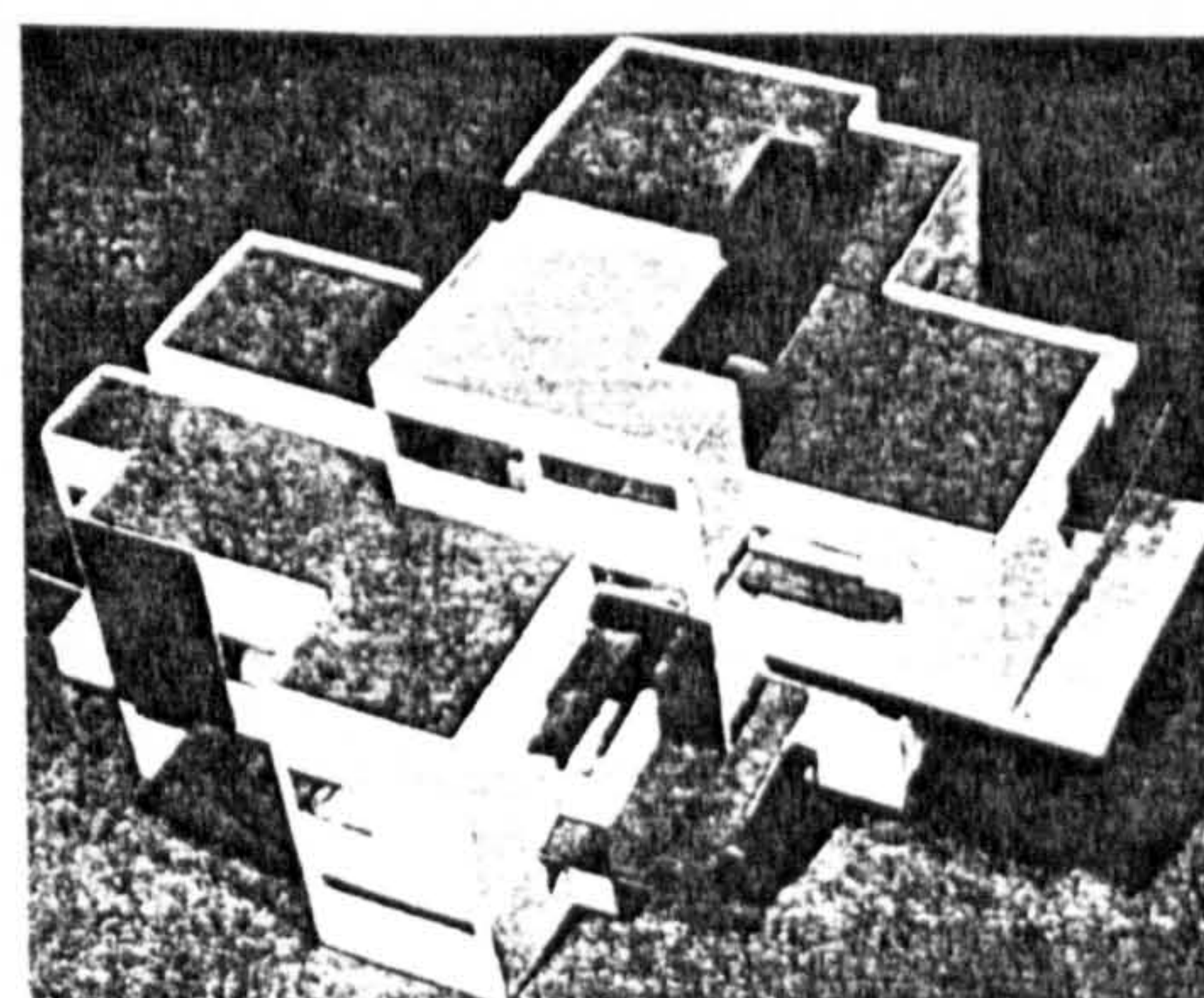
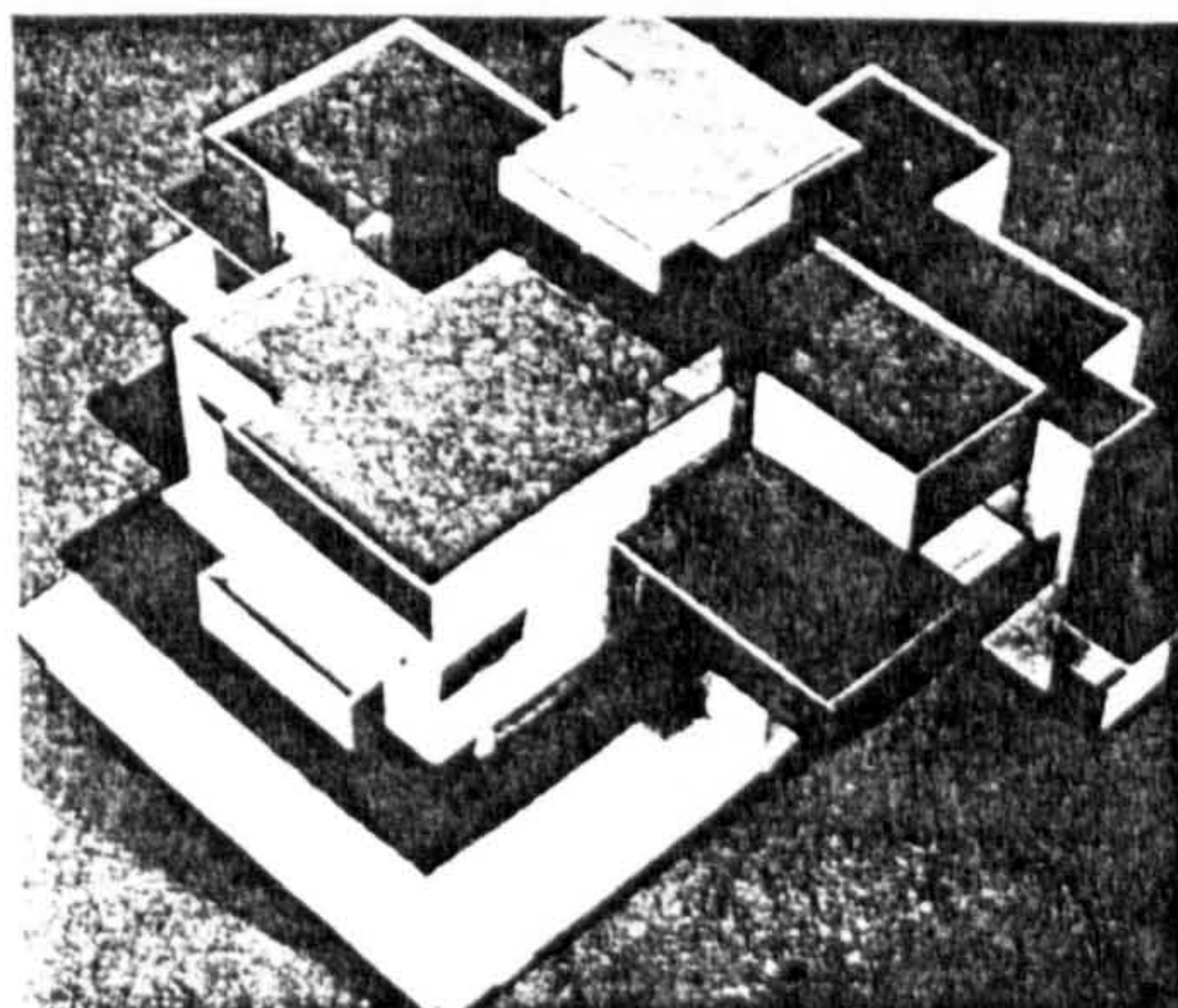


Fig. 264. Plans for a private house, 1920, by T. Van Doesburg and C. van Eesteren⁵

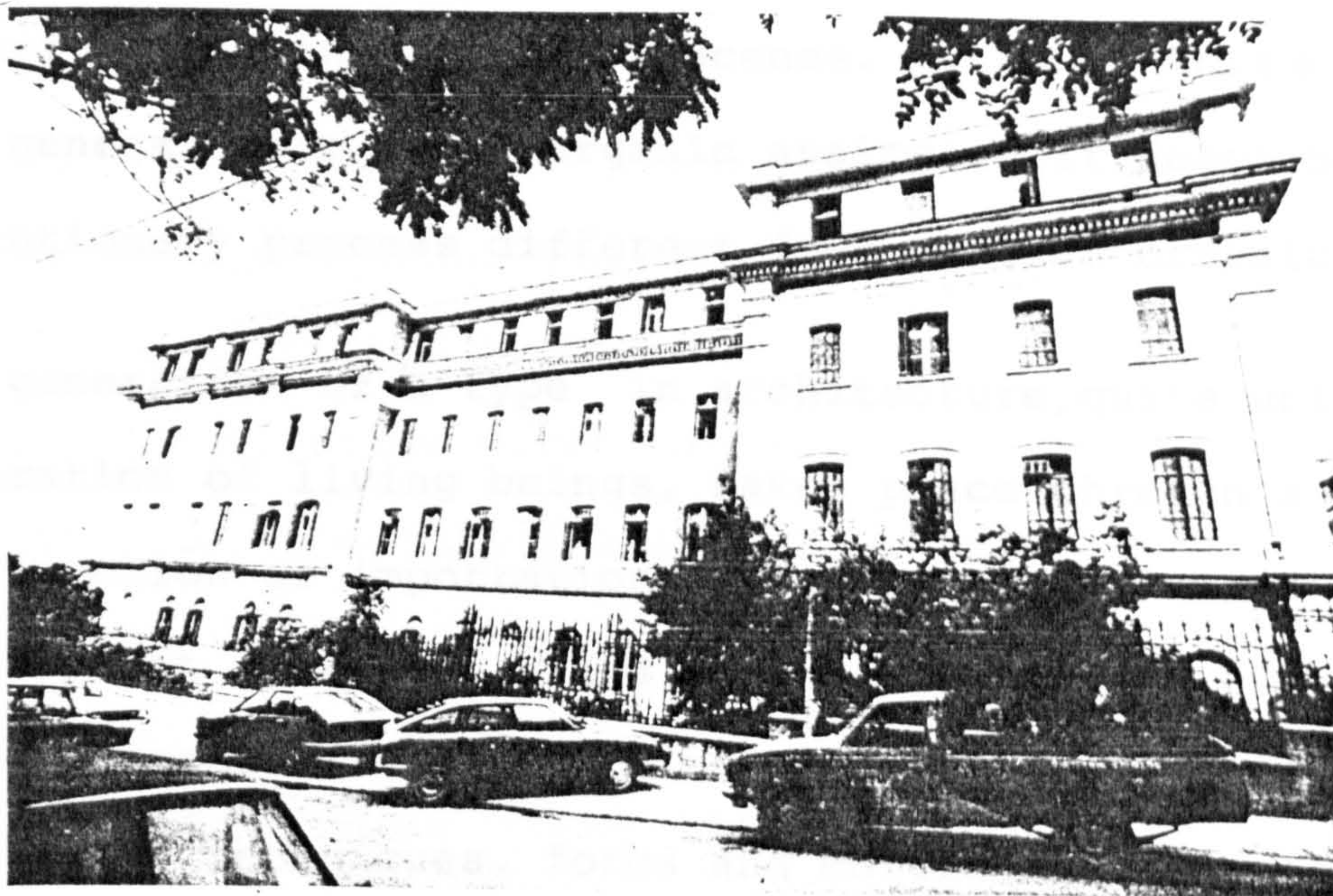


Fig. 265. City Hall in Thessaloniki, 1891, by V. Poselli⁶



Fig. 266. Corn Mill in Thessaloniki, 1851, by V. Poselli⁷

Throughout the work an important issue has been raised concerning the nature of type. There is an organic conception of type which is reflected by the fact that the life of a type follows a pattern of generation, rise, maturity, decline and obsolescence. Although this schema in its general form shows organic analogies, it describes an evolutionary process different from that of organic beings.

The generation of a type in architecture, quite unlike the generation of living beings, takes place through a process of invention or importation. By invention is meant the development of a type based on local needs and use of local characteristics which mainly refer to building materials, techniques, forms and motifs and does not have to rely on foreign prototypes. The importation of a type is a process which occurs through two channels. In the first case the designer is influenced by and uses a type that has been developed already in another country. In this process of transfer, which is exemplified in the *box mill*, the designer adapts the new type to local particularities and to local materials and techniques. In the second case of importation, which is less adaptable to local conditions than the previous ones, the transfer of the new type takes place through the client who imports the machinery with the projects of the factory (the *serrate building*), or employs an architect who copies the foreign prototype (the *monumental building*).

A type after its generation and trial gets its constant characteristics. There is sometimes a short period of

stabilization of certain traits. This situation occurs in two cases. Firstly, when a type is imported and its initial output is based on the use of materials which are not used and produced locally; then a period follows for the adaptation of the type to local particularities. This is clearly illustrated in the way the *monumental* factory is established in Greece. The first application is a corn mill (fig. 6) constructed in Thessaloniki in 1851. It is a load bearing construction with iron columns. The only manifestation of this type in mills (ATTICA SPINNING AND WEAVING INDUSTRIES, 1925) is of skeletal construction with reinforced concrete columns. Thus, in mill design reinforced concrete can be considered as one of the attributes of the type.

When a type is generated in a period of introduction of a new building material, a short period intervenes between the first manifestations of the type and the followings which are based on the recently widespread material. This issue is exemplified clearly in the case of the *serrate building*. The first application of this type in mills in Greece (A.7) is a wooden construction. All the other mills which have been built later on, are reinforced concrete structures. Thus, the use of concrete as a building material can be considered as one of the features of this type despite the fact that the first mill which originally applied it, has been made of wood.

The delay in the acquisition of the stable characteristics of the type is always due to building materials and methods of construction, in other words due to the means of the technical realization of buildings. Additionally, there

are cases when a type in decline may change those characteristics which are related to the constructional materials. For instance, the last example of the *vernacular building* (the extension of A. 6 mills) is made of reinforced concrete, though wood is one of the dominant attributes of the type. It is obvious that unstable traits, at least at the beginning or the end of the life of the type are those related to materials and techniques. It is easy to imagine the basic principles remaining unaltered when they are accompanied by changes in materials and constructional techniques. What is important after all are the formal traces of a technique and the textual quality of the materials rather than the operations and the material substance as such.

A type does not last for ever and has a limited life span and often its materializations coincide with the manifestations of other types, as is the case of the *vernacular building*, the *serrate*, the *multi-storey block* and the *complicated* which have been built in the period 1920-40 and also after the 1960's the *box* and the *pluralistic*. It is easy to assume that the large number of coexistent types in a certain period is due to the pluralism of modern industrial societies, which is characterized by continuous renewal and proliferation of human needs, materials, techniques and changing architectural design ideologies. Considering the present situation of architectural practice in developed countries, this is true. However, mill designing in Greece offers a different answer. It is mainly the ambivalence of a certain period expressed in a gap between

human needs and the means to satisfy them, that leads to the creation of many types. For instance, with the rapid industrialization in Greece after 1920, a problem arises in textile manufacturing: the design of buildings to properly house the industrial activity. In parallel, there is an uncertainty about the means to achieve it because the 'need' is not yet clear and in a way it poses questions which are open to many different answers. In contrast, after 1960 the 'need' becomes clear and definite and the available technical means to the designer are adequate to satisfy the need. As a result the *box* is developed as a dominant and common type, the only one so widespread.

The biological analogy which is apparent in the pattern of life of each type does not characterize the transition from one type to another. Types undergo revolutionary rather than evolutionary changes and establish discontinuities in history which become like a broken chain. Their succession is not characterized by transmission of many characteristics from the old to the new. This particular feature discloses the difference between 'form types' and 'biological types'⁸. Biological types are continuously manifested and the hereditary information is transmitted 'endosomatically', that is through the bodies of their actual manifestations. Form types in architecture alter under exogenous changes and whatever information is passed from one to the other is done 'exosomatically', through those involved in design, and particularly through the designer who follows a process which is affected by socio-cultural values and human

purposes and intentions. Thus the relationship between successive types in architecture is quite similar to that of types in archaeology.

In the following figure the interrelationship of mill types is illustrated in terms of the traits which are transferred from one to the other. These characteristics relate mainly to the materials, the form of the roof and the inside-outside relationship.

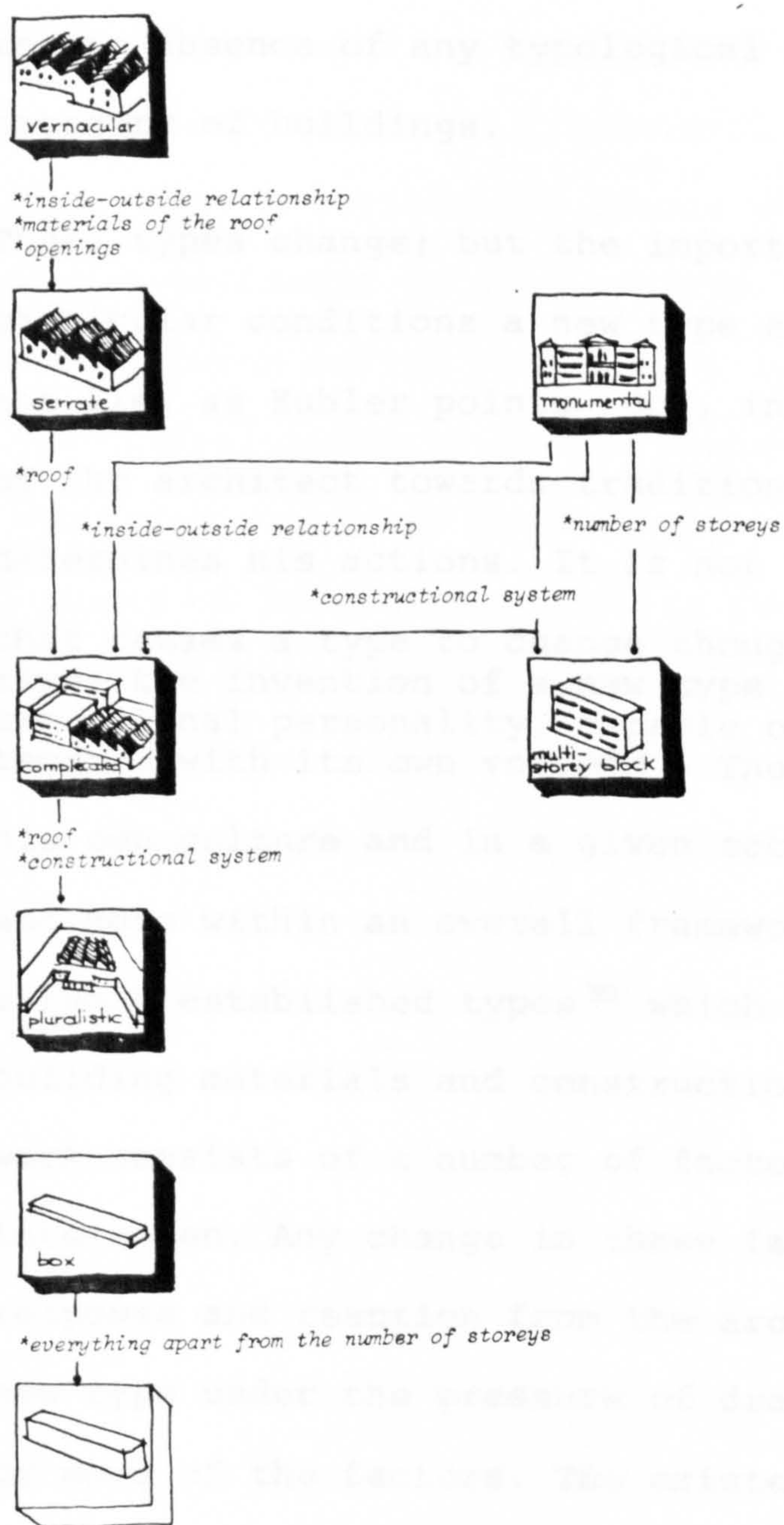


Fig. 267.

Thus, it may be argued that mill types have mainly the characteristics of 'independent' types and not of 'transform' types, although the *double-storey box* can be considered as a 'transform' type of the 'box'. The dominance of 'independent' types on the 'transform' in terms of numbers is apparent in the typological analysis of mills, yet it is very difficult to argue whether this fact mirrors a similar situation in other building classes. This is due to the absence of any typological analysis of any other category of buildings.

Thus, types change; but the important issue is under which particular conditions a new type emerges. The answer does not lie, as Kubler points out, in the rebellious attitude of the architect towards tradition which directs and determines his actions. It is not the architect's will

that causes a type to change though, as Moneo argues, "sometimes the invention of a new type is the result of an exceptional personality, capable of entering into architecture with its own voice"⁹. The architect works within

his own culture and in a given social and historical context and acts within an overall framework part of which are already established types¹⁰ which are tied to human needs, building materials and constructional methods. This framework consists of a number of factors tightly and differently interwoven. Any change in these factors causes a particular response and reaction from the architect. He may invent a new type under the pressure of dramatic alterations in one or more of the factors. The existence of an exceptionally creative personality may be one of the necessary preconditions but it is not a sufficient cause for the emergence of a new type.

The determining factors do not always exercise the same influence on the designer. This can be illustrated with the analysis of the factors which lead to the emergence of some of the types of mills. The existence of a rich tradition in housing design concerning the forms, materials and techniques, combined with the absence of any previously established industrial forms, and the small size of textile firms at the end of the nineteenth century facilitates the birth of the *vernacular building*. Furthermore, an important factor is the involvement of traditional builders in factory construction. A legislative change which has obliged professional engineers to get involved in factory design is the main impetus behind the *serrate building* but not the only one. Additionally, it is the professional status of the engineers which has conditioned the importation of a type - instead of invention - that is favoured in Southern Europe and initially has originated from the need to illuminate with natural light single-storey shopfloors. The existence of the proper material means (concrete) and techniques at the same period in Greece are the necessary preconditions from which the *serrate building* derives. The *complicated building* is the result of purely economic factors related to financial restrictions, and the existence of badly shaped firms, which have been the outcome of the economic crisis. The *box*, on the contrary, is the result of changes in the size of the industrial firms, in their competitive policy, in the production process and in the environmental conditions imposed by the need to improve the quality of the products and to create a better environment.

Thus, there are many factors which constitute a kind of historical network within which the designer is bound to act. These factors are the economic conditions, the socio-cultural circumstances, the geographic and climatic environment, the legislation, the technological and material means of construction, the heritage of the built environment and the body of scientific knowledge or otherwise which is acquired by the designer through his education and professional practice.

The relative importance of every factor in each historical period, and the degree of their impact on the designer are different. The number and kind of factors vary between the building classes. For instance, the influence of the level of development of technology is more decisive on factory design than on any other building class. Technology influences the design of industrial buildings through two channels. The first is related to building materials and techniques, in other words to the construction industry, and affects in a similar way all building classes. The second channel is related to the industrial machinery and the production process and has a very important effect on factory design. This is probably the reason why types of industrial buildings tend to alter quickly. On the contrary, the changing architectural ideologies are reflected more clearly on villas or public buildings than on factories, since in the former financial restrictions and clients' impositions are usually not strict and allow the designer to manoeuvre easily and make stylistic gestures. In the case of factories the strict impositions of the production

process and the client's priorities to this process limit many times considerably the architect's freedom.

The question that arises is whether the continuous and repetitive manifestations of a type depend on the factors which conditioned its emergence remaining in existence or on the way designers act during design by copying an already established type. The situation of reoccurrence can be attributed to both factors since they are interrelated; the former as the functional-environmental origin and the latter the genetic. However, there is not enough evidence, derived from the survey, on the influential impact of the second factor which involves issues of the design process and mainly the architects' way of conceptualizing during designing. This situation resulted from the fact that the designers of mills were basically unknown. The only indication that there may be a kind of genetic lineage between buildings which belong to the same type is the statement of the designer of SIGARAS, C. WOOL, INDUSTRIES (A.12) who has stated in an interview that he has used as a source of inspiration the PELLA OLYMPOS Mills (A.10), in Naoussa, and where as a child he watched his father supervising, as foreman, the construction works.

This aspect raises the final issue which is the relationship of typology and design and the widening of the role of types from descriptive and taxonomic devices to operational and normative tools. It is quite beyond the scope of this study to make any theoretical analysis of the creative process of

the designer, and the need to intermingle types in design based on the idea to combine and reconcile 'change' and 'continuity'; the two aspects of historical evolution. The modern Rationalists and other theorists such as A.Colquhoun and B.Hillier *et al*, whose ideas have been presented in chapter 4 argued for the inevitable relationship between types and design based on the general consideration that buildings can communicate meanings when they reveal and embody preestablished form-types. Those contemporary architects who employ types as mechanisms of compositions and as motivating forces of their creativity have stripped the notion of its holistic character. The type is reduced to an idea or to a formal element and in both cases it is merely an independent fragment. Thus, one is confronted with a broken entity scattered into pieces and the buildings can be considered with difficulty as expressions of a known type.

At the most general level without going into the core of the problem a final point should be made concerning the concept and use of type. The taxonomic utility of types can be found in the historical description of the built environment which seeks to embrace all of its components (buildings) independently of their style or their designer, and to reveal their common formal principles. R.Moneo very correctly points out that there is an "... extreme difficulty in applying the concept of type to current architecture, in spite of our awareness of its value in explaining a historical tradition"¹¹.

If design action wants to benefit from this analytic and taxonomic tool, and transform it to an operative instrument, for reasons related to a 'normative view of history'¹², it

should do so on the basis of the knowledge of the meaning of the term, its potentialities, its limitations and mainly its holistic character.

GENERAL CONCLUSIONS

There have been two aims to the thesis, as was stressed in the main introduction. The first was to study the history of mill buildings in Greece since the end of the nineteenth century; the second to develop a typological method of analysis and assess it in application to the mills.

The character of the thesis has been taxonomic and historical. Namely, there has been an exploration into how and why mills evolved by arranging them into groups according to their common features, and an attempt was made to achieve a historical reconstruction on the basis of types. Furthermore, through the case-study, a number of theoretical issues related to the ontogeny of types were explored. These have remained untouched in architecture so far. These issues are analysed in chapter 7.

The work has followed a process of interplay between the development of the typological method and its application in the study of a particular class. Accordingly, the conclusions of the thesis may be summarized in two categories. The first is concerned with the methodology. These conclusions refer to the nature of types, to the procedure of the identification of types and to the evolutionary life-pattern of the types. They are drawn mainly from chapters 4, 5 and 7. The second category contains those which deal with the historical evolution of mill types in Greece (chapters 5 and 6). In this section, instead of repeating these conclusions, I shall concentrate on more general ones by giving an account of the good and bad points of the typological approach and by exposing its descriptive strength in the analysis of mills.

We can grasp the history of buildings by rearranging them into classes, types or stylistic categories. As G.Kubler stresses "it is in the nature of being that no event ever repeats, but it is in the nature of thought that we understand events only by the identities we imagine among them"¹. The three analytical tools express three ideologically different methods of historical analysis. Classification is at the one end and as has been analysed in chapter 4 it tends to be mechanical and superficial. Its more important limitation is that it leads to the fragmentation of the buildings by isolating particular aspects of them on the basis of which the classification is achieved. It leads to the formation of collections of plans, facades or other architectural elements such as windows, doors, roofs etc., which are parts of a whole that has been lost. The abstract schema of the plan is usually the taxonomic criterion for the classes.

At the other end of the analytical spectrum there is the conventional architectural history of styles and architects. This tends to be arbitrary since it is controlled and directed by the choices and interests of the historian. It is influenced by his task, it depends on his judgement and that of his peers and thus, it is open to ideologically based distortion. Furthermore, it gives praise to individuality and presupposes that only the buildings which are designed by famous architects or have a stylistic delicacy are worth studying.

In between lies typological analysis which is neither mechanical nor arbitrary. Like classification it enables the researcher to bring order to a large number of buildings

which usually cannot be subjected to a conventional stylistic analysis and whose designers are either unknown or do not adhere to any known architectural school of thought. Also, as opposed to conventional historical analysis, it enables the inclusion of buildings of no particular specifically architectural merit. It holds to the view that the architectural spirit of an age is expressed in all buildings irrespective of the quality of their architecture. Thus, it gave analytical value to a number of mills - mainly those belonging to the *complicated* type - which are not perceived to be of any stylistic and architectural importance. However, they have a historical importance since the built environment includes, apart from unique examples, both replicas and transfers and also good and bad ones which are related to one another by the bonds of influence or tradition. Thus, typological analysis 'portayed' reality in mill designing in a more or less accurate way by dealing with a representative sample of the whole.

Comprehensiveness is the most fundamental aspect of typology. The typological approach enabled the wholistic treatment of mills and allowed a shift from partial to complete description. It did not isolate and segment them according to their constituent aspects, but it identified all those groups of textile buildings which had a complete set of these aspects in common. The fragmentation of each mill, was not entirely avoided, at least in the first stage of the definition of each type, yet, finally all features (the articulation of spaces, the spatial volume, the formal structure and the means of technical realization of buildings) are recombined to

formulate the type as a tightly interwoven network,

Thus, the typological approach forces a shift in historical analysis towards the adoption of the comprehensive mechanisms used in the design process. Buildings are perceived during design as complete entities and not as a cluster of fragments and are products of a set of ideas which refer to them as a whole. In a similar way, in typological analysis, mills were treated as complete entities; a fact which resulted in a more accurate 'reading' of the practice of mill designing.

The typological analysis as assessed through the study of mill buildings has shown its descriptive strength in that it enabled the description of mills based not purely on their formal characteristics but also on the qualities and ideas underlying them. It is aimed at the internal coherence of buildings and thus it stressed their connections more than their individual aspects. The thesis has shown that these connections can be detected by exposing the common ideas which gave birth to a set of mills which may not look alike on superficial examination. For instance, the *vernacular building* encompasses a number of mills which have quite different configurations-pertaining to Macedonian or Syrian houses-, yet all have a common underlying idea: the intention to adapt and refer to local traditional architecture.

Thus, whereas the notions of style and class refer mainly to external characteristics, the concept of type transfers description to a deeper level, to the ideas lying beneath the form. Ideas are not regarded merely as abstract motivating forces related to the intentions of the designer, but are

always considered in connection with their formal manifestations. So, the buildings were put into types according to what they are and the ideas which are explicitly expressed through their formal features, independently of the ideas which might have lain behind their design in the minds of their designers.

Typological analysis allowed inter-temporal and cross-regional comparisons. The various types were materialized in various periods and regions. However, since the main concern of typology is to focus upon the buildings and their relationships, priority was given to the investigation of their common attributes without taking into account, in the first place, issues of regional and temporal coexistence. This then led to comparisons between different geographical areas and historical periods.

The typological approach showed its limitations by failing to encompass all the buildings under examination. It was not found possible to incorporate into the 7 identified types a small number of mills. The 7 types and various syntheses of them cover the whole set of 57 mills with the exception of 4 which were presented in chapter 5 under the heading 'problematic cases'. Furthermore, a few of the types have a small population; a fact which might have resulted in an imprecise definition of their constituent elements. This was probably due to the size of the sample. An increase of the number of buildings under study might lead to some slight alterations of the constituent characteristics of the type.

The principle limitation of the present work - though not of the use of typologies - is that the application of the typological analysis was made to only a single building class. This meant that the investigation of issues related to the ontogeny of types was inevitably affected by the particularities of mills. It would have been desirable to strengthen the theoretical conclusions of the thesis by taking into account the specific qualities of other building classes, but this was not possible within the time available.

This work, therefore, cannot be regarded as a final statement on typology in terms of theory and application, but rather as the formulation of a framework within which typological analyses of other building classes can be usefully carried out.

NOTES & REFERENCES

INTRODUCTION

1. J.P.BONTA, 'Architecture and its Interpretation', Lund Humphries Publ. Ltd., London, 1979, p. 118
2. Ibid., p. 103
3. P.FRANKL, 'Principles of Architectural History: The Four Phases of Architectural Style, 1420-1900', MIT Press, London, 1968 (Transl. and Ed. by J.F.O'Gorman. Originally publ. in Germany in 1914).

CHAPTER I

1. N.P.MOUZELIS, 'Modern Greece: Facets of Underdevelopment', MacMillan Press Ltd., London 1978, pp. 11-17
2. Important works referring to this particular period are:
X.ZOLOTAS, 'Greece in the Stage of Industrialization', (in Greek), Ed. by Bank of Greece, Research Works No 6, Athens, 1964, (© 1926) - G.HARITAKIS, 'The Greek Industry: Industry, Mining, Labour', (in Greek), Estia, Athens, 1927 - and G.KORDATOS, 'Introduction to the History of Greek Capitalism', (in Greek), Epikerotita, Athens, 1930.
3. N.P.MOUZELIS, op.cit., p. 17
4. 'Structural' interference refers to observable and measurable dependencies (military, political, economic and cultural) of the small nations on the advanced, whereas 'manipulative' interference takes place through diplomatic and political channels of influence. The distinction between 'structural' and 'manipulative' is analysed in T.A.COULOUMBIS, J.A.PETROPOULOS, H.J.PSOMIADIS, 'Foreign Interference in Greek Politics: A Historical Perspective', Pella Publ. Co, N.Y., 1976, pp. 147-148
5. According to a survey of the *Société des Nations*, 'L' Etablissement des Réfugés en Grèce', Geneve, 1929, p. 183, there were two categories of refugees: the small industrialists who represented 65% of the whole and the

wage workers who made up the other 35%.

6. Details of the inter-War foreign borrowings may be found in 'The Balkan States: A Review of the Economic and Financial Development of Albania, Bulgaria, Greece, Romania and Yugoslavia since 1919', specially prepared for and with the assistance of the Information Department of the Royal Institute of International Affairs, Oxford University Press, London, 1936.
7. N.P.MOUZELIS, op.cit., p. 24
8. N.G.SVORONOS, 'Histoire de la Grèce Moderne', (in Greek as well), Presses Universitaires de France, Paris, 1972 (Themelio, Athens, 1976, p. 130).
9. These trends and their consequences are analysed briefly and criticized by A.A.KINTIS, The Post-War Industrial Policy, (in Greek), ECONOMICOS TACHIDROMOS, 28.1.82, pp. 31-33. The two trends were expressed in two opposed reports submitted to the Greek government with the aim of suggesting the lines according to which the American aid could be used to stimulate the economic development; the first was submitted by Barbaresos and the second by the team X.Zolotas, I.Zigdis and I.Koulis. Discussions on those trends are found in L.NIKOLAIDIS, The Effort for Industrialization was Founded on the Programme of 1948, (in Greek), ECONOMICOS TACHIDROMOS, 9 Dec. 1971, pp. 19-10, I.ZIGDIS, The Industrialization of Post-War Greece and the Essential Role of UNRA, (in Greek), ECONOMICOS TACHIDROMOS, 6 Jan. 1972, pp. 15-16, and also in X.ZOLOTAS, The Beginning of Industrialization in Greece, (in Greek), ECONOMICOS TACHIDROMOS, 13 Jan. 1972, pp. 11-12 and 32a.
10. A critical analysis of this Legislative Decree and its future additions (1961 and 1962), which offered extreme privileges to foreign investors, may be found in H.S.ELLIS in collaboration with D.D.PSILOS, P.W.WESTEBBE and C.NICOLAOU, 'Industrial Capital in Greek Development', Centre of Economic Research, Research Monograph Series 8, Athens, 1964, pp. 275-301.

- 11.H.S.ELLIS *et al*, op.cit., p. 133
- 12.N.P.MOUZELIS, op.cit., p. 28
- 13.For an analysis of these characteristics see T.FOTOPOULOS, Dependent Development and Industrialization, (in Greek), in S.PAPASPILIOPOULOS (ed) 'Studies of Contemporary Greek Economy', Papazisis, Athens 1978, pp. 61-121
- 14.X.ZOLOTAS, op.cit., p. 122
- 15.R.F.DUKE, Report of the Industrial and Economic Situation in Greece, July 1923, London, pp. 33-34, cited in G.HA-RITAKIS op.cit., pp. 43-44
- 16.The figures are cited in the STATISTICAL SERVICE OF GREECE, 'The Statistical Yearbook of Greece', 1920, 1930 - 'The Census of Industrial, Handicraft and Commercial Establishments', 1920, 1930 - 'The Statistical Summary of Greece'. 1954 - 'Economic Yearbook', 1938.
- 17.DEMATHAS, About the Industrial Development of Greece, (in Greek), ATTICA CALENDAR, 1877, pp. 397-348
- 18.JOLYON DRURY, 'Factories: Planning, Design and Modernization', The Architectural Press, London 1981, p. 5
- 19.G.CORDATOS, op.cit., p. 79
- 20.MINISTRY OF NATIONAL ECONOMY, Report on Greek Industry, (in Greek) part of which was published in ERGA, No 152, 30 Sept. 1931, p. 221
- 21.G.COUTSOUMARIS, op.cit., pp. 137-138
- 22.An extensive analysis of this policy and its effects on the regional development of the country is made by E. ANDRIKOPOULOU-KAFKALA, 'State Intervention and Regions: The Disposition of Regional Space in Greece', (in Greek), Doctoral Thesis submitted in the Dept. of Architecture of the Aristotle University of Thessaloniki, Thessaloniki, 1984.

23. The only studies which analyse the problems of the textile sector in Greece are as follows: CENTRE OF ECONOMIC PLANNING AND RESEARCH, 'Development Programme 1976-80: Textile Industry-Clothing', (in Greek) Report of Team Work No 9 - INSTITUTE OF ECONOMIC AND INDUSTRIAL RESEARCH, 'Greek Textile Industry and EEC', (in Greek), Athens, 1978, p. 189 - 'The Greek Textile Industry', (in Greek), Publ. of the Commercial Bank of Greece, Dept of Economic Studies, Branch Studies No 5, Athens, 1981, p. 35 and S.ARGIROU, I.CHASID, A.KOUVAS, I.AIVAZIS, 'Branch Study for the Textile Industry in the Framework of the 5-year Programme', (in Greek), (unpublished).
24. ELIOT GRINNELL MEARS, 'Greece Today: The Aftermath of the Refugee Impact', Stanford University Press-Oxford University Press, California, Oxford, 1929, p. 110.
25. Ibid., p. 104/5
26. Ibid., p. 104/5
27. H.S. ELLIS *et al*, *op.cit.*, p. 20
28. Ibid., p. 152
29. G.KAFKALAS, 'Regional Organization of Industry: Completion and Restructuring in the Decade 1969-78' (in Greek), Doctoral Thesis submitted to the Dept. of Architecture, Aristotle University of Thessaloniki, 1984
30. CENTRE OF ECONOMIC PLANNING AND RESEARCH, *op.cit.*, p.84 and 108.
31. N.SIDERIS, 'Greek Industry: Industrial Production and its Value in 1953 and 54 in Comparison with 1939 and 1949', (in Greek), Athens 1955, p. 96
32. CENTRE OF ECONOMIC PLANNING AND RESEARCH, *op.cit.*, p.69

CHAPTER II

1. A brief analysis of different kinds of fibres may be found

in the 'Encyclopaedia of Occupational Health and Safety', INTERNATIONAL LABOUR OFFICE, Technical Editor: Dr.Luigi Parmeggiani, 3rd Ed. Two Volumes, Geneva 1983, under the headings: FIBRES, NATURAL-FIBRES, MAN-MADE SYNTHETIC-FIBRES, MAN-MADE GLASS AND MINERAL-FIBRES, NATURAL MINERAL and also in B.C.GOSWAMI, J.G.MARTINDALE, F.L.SCARDINO, 'Textile Yarns: Technology, Structure and Applications', John Willey & Sons, N.Y. 1977.

2. B.C.GOSWAMI *et al*, p. 273
3. Ibid., p. 274
4. Analysis of the process is given in J.B.AITKEN, 'Automatic Weaving', Columbre Press, Manchester & London, 1964.
5. All photographs from fig. 7 to fig. 15 are from advertizing leaflets of Greek companies.
6. A discussion on the various types of looms is given in GEGARD K. BOON, 'Technology Transfer in Fibres, Textile and Apparel', Sijthoff & Noordhoff, Alphen aan den Rijn, The Netherlands, Rockville, Maryland, USA, 1981, pp. 158-162.
7. All buildings of the survey are denoted with the letter A for Appendix and a number referring to the serial number of their drawings in the Appendix.
8. In worsted system, which resembles the cotton system, fibres in carding, gilling and combing are kept parallel and the shorter fibres are rejected and the yarn which is produced is strong and fine. In contrast, in wollen system the fibres intermingle to form a soft and fluffy yarn.
9. DEREK SUGDEN, 'Factories, AD, No 2, 1974, p. 94
10. J.WINTER, 'Industrial Architecture: A Survey of Factory Buildings', Studio Vista, London 1970, p. 20
11. The 'Technical Chamber of Greece' established in 1923 on the basis of the Legislative Decree 1/23.11.1923. Its official magazine started being published in 1932. Cited in

G.PSOUNIS, The Engineers and the Technical Chamber of Greece, (in Greek), INFORMATION BULLETIN, 1000, 3.6.78, p. 70

12. In 1902 the Thomson Houston de la Méditerranée factory. Cited in K.BIRIS, 'The Athens of Nineteenth and Twentieth Century', (in Greek), Athens, 1966, p. 83
13. An analysis of every factor and the measures that should be taken to prevent them is given in INTERNATIONAL LABOUR ORGANIZATION, 'Safety and Health in the Textile Industry', Textiles Committee, Ninth Session, Geneva, 1973
14. 'Shuttle Kissing' describes a number of infections that can be caused to workers when they use the traditional way of threading a shuttle by drawing the yarn through the shuttle-eye by mouth suction. Cited in 'Cotton and Allied Fibres Health and Safety 1971-1977', HMSO, Publ. p. 12
15. INTERNATIONAL LABOUR ORGANIZATION, op.cit., p. 21
16. LUDWIG UTZ, 'Moderne Fabrikanlagen', Uhlands Technischer Verlag, Otto Politzky, Leipzig 1907, and also HENRY GRATAN TYRRELL: 'A Treatise on the Design and Construction of Mill Buildings and other Industrial Plants', The Myron C.Clark Publ. Co. Chicago, N. York, London 1911.
17. After the War, books on industrial building design were advocating methods of artificial venting; for instance, in 'Industrial Buildings: The Architectural Record of a Decade', Compiled by Kenneth Reid, Publ. by F.W.DODGE Co, N. York, 1951, and also LEON GRIVEAUD, 'Traité Pratique de Construction et Aménagement des Usines', Librairie Polytechnique Ch.Béranger, Paris, Liège, 1951
18. JOLYON DRURY, op.cit., p. 177
19. One can easily recognize quite identical expressions on the task of lighting in books written in 1911, 1919 and 1975 as well; for instance, in H.G.TYRRELL, op.cit., p.

- 79, E.G.W.SOUSTER, 'The Design of Factory and Industrial Buildings', Scott Greenwood & Son, London 1919, p. 30 and in M.BOURDERIOUX, op.cit., p. 8.
- 20.E.G.W.SOUSTER, op.cit., p. 31
- 21.Ibid., p. 32
- 22.LISE GRENIER, HANS WIESER-BENEDETTI, 'Les Châteaux de l'Industrie: Recherches sur l'architecture de la région Lilloise de 1830 à 1930', Tome II, Edité par les Archives d'architecture Moderne et le Ministère de l'Environnement et du Cadre de Vie-Direction de l'architecture, Paris-Bruxelles, 1979, p. 22
- 23.Ibid., p. 136
- 24.J.DRURY, op.cit., p. 126. A juxtaposition of two kinds of opinions is given in OSWALT GRUBE, 'Industrial Buildings and Factories', The Architectural Press, London 1971, p.18-20
- 25.TEXTILES COMMITTEE, op.cit., p. 41
- 26.O.GRUBE, op.cit., p. 20
- 27.E.G.MEARS, op.cit., p. 112
- 28.G.LEFKADITIS, The Importance of Lighting in Industry (in Greek) ERGA, No 111, 15 Jan 1930, p. 382
- 29.INTERNATIONAL LABOUR OFFICE, 'Blanchard Report', Athens, September 1978
- 30.A general picture of the working environment from the technical, environmental, and statutory point of view is given in 'Research on the Working Environment in the Industrial Sector', (in Greek), Technical Chamber of Greece, Permanent Committee on issues for Environmental Conditions, Athens, Sept. 1981, and also in T.VALAVANIDIS, Workplace Pollution and Problems of Health and Safety of Workers , (in Greek) SYCHRONA THEMATA, No 7, 1980, pp. 79-90

31. The first was Law ΓΑΔ' 19/21 Nov. 1911, 'About the Health and Safety of Workers and the Daily Hours of Work' . Later were the Royal Decree 25 Aug./5 Sept. 1920, 'About the Health and Safety of Workers', the Presidential Decree 22/29 Dec. 1933, 'About the Health and Safety of Workers and Clerks in Every Kind of Industrial Establishment', the Presidential Decree 12/17 Jan. 1934, 'Regulations on the Prevention of Accidents in Open Air Works', and finally the Presidential Decree 13/22 Mar. 1934, 'About the Health and Safety of Workers and Clerks in Every Kind of Industrial Establishment'.
32. Presidential Decree 13/22 Mar. 1934, Chapter V on Lighting, Articles 18 and 19
33. Royal Decree 15/21 Oct. 1922. It was based mainly on two previous decrees of 1912 and 1922 which were not worked out in details.
34. The Future of Greek Industry and the Role of Workers , (in Greek), paper presented by a group (E.LE.MEP.) in the Symposium on 'Industry in Greece' organized by the Technical Chamber of Greece (Feb. 1981). The paper is published in SYCHRONA THEMATA, No 11, Jul. 1981, pp.27-35
35. Commercial Bulletin: Prices of Building Materials in the Market of Athens and Piraeus , (in Greek), compiled by N.B.SALIVEROS, in ARCHIMIDIS, No 2, June 1908, pp 23-24
36. All information was given by the president of the firm to a group of engineers who visited the factory in 1906. In parallel, he analysed the methods of cement production and referred to a few constructions made of reinforced concrete in Greece. Cited in 'Description of an Excursion in the Hellenic Factory of Cement of Hadjikiriakos, Zacharias and Co', a report published in ARCHIMIDIS, No 2, June 1906
37. Advertisements in ARCHIMIDIS, No 12, Apr. 1907, a monthly magazine of the 'Greek Polytechnic Association'
38. I.ANGELOPOULOS, Building of A.Afentouli, (in Greek), ARCHIMIDIS, No 11, Mar. 1907, p. 134

39.Ibid., p. 135

40.I.Angelopoulos obtained his diploma in civil engineering from Paris and was the agent of the Hennebique Company in Greece.

41.I.ANGELOPOULOS, op.cit., p. 137

42.D.KALIVAS, About the Reinforced Concrete or Composite Structures, (in Greek), ARCHIMIDIS, No 12 Apr.1907 and No 1 & No 2 May & June 1908

43.The first Chair of 'Structural Analysis, Iron Constructions and Reinforced Concrete' was established in 1916.

44.All factors are analysed in H.S.ELLIS *et al*, op.cit., pp. 206-216

45.The problems of Greek architecture and contemporary technology are briefly discussed by F.LOYER, A Critique of Contemporary Greek Architecture, (in Greek with English extensive Summary) ARCHITECTURE IN GREECE, No 2, 1968, pp. 28-30

46.S.KONTARATOS, From Traditional to Modern Materials: The Designer must be a Creator and not simply a Consumer, (in Greek), ECONOMICOS TACHIDROMOS, No 1054, 4 Jul. 1974, p. 12

47.K.T.TRIANTAFILLIDIS, Problems of Introducing Prefabrication in Greece in 'Structural Prefabrication', (in Greek), Technical Chamber of Greece Ed. Prof. K.BIRIS, Athens 1973, pp. 442-444

48.According to Prof. T.Tassios prefabrication started being taught in the Technical University of Athens in 1952 as part of the course: "Reinforced concrete". However, the systematic teaching of the theory and application of prefabrication was done by T.Tassios from 1969 onwards.

CHAPTER III

1. ICAP, 'Financial Directory of Greek Companies', Athens, 1982

2. P.KABOUROGLOU, 'History of Piraeus from 1833-1882', (in Greek), Publ. Asmodeos, Athens, 1883
3. The photograph is taken from G.CHRISTOPOULOS, 'Thessaloniki During the Last Hundred Years', (in Greek), Enosis, Thessaloniki, 1936, p. 217
4. The photograph is taken from COMMERCIAL AND INDUSTRIAL CHAMBER OF GREECE, 'D.Hadjopoulos', Thessaloniki 1966 p.91
5. A brief analysis of the evolution of the architecture of the island is given by ANASTASIOS KARTOS, 'Syros', (in Greek), Publ. Melissa, Athens, 1982
6. Ibid., p. 11
7. D.PORPHYRIOS, Classicism is not a style, A.D. 5/6, 1982, p. 55
8. S.B.SCOPELITIS, 'Neoclassical Buildings of Athens and Piraeus', (in Greek and English), Gnosi, Athens, 1975
9. H.G.TYRRELL, op.cit., p. 188
- 10.LISE GRENIER, HANS WIESER-BENEDETTI, op.cit., p. 103
- 11.G.HILDEBRAND 'Designing for Industry', MIT Press, London, 1974, p. 40
- 12.LISE GRENIER, HANS WIESER-BENEDETTI, op.cit., p. 136
- 13.The photograph is from G.CHRISTOPOULOS, op.cit., p. 214-215
- 14.Ibid., p. 215-216
- 15.A brief presentation of the movement is in A.S.GIACUMACATOS, European Rationalism and Greek Architecture during the Period between the Wars. A Critical Review of the Autochthonous Architectural Production, (in Greek and English Summary), ARCHITECTURE IN GREECE, No 16, 1982, pp. 75-92

- 16.B.KASSANDRAS, Ernestos Tsiler, (in Greek), TECHNICA CHRONICA, Feb. 1939, p. 128
- 17.H.HILDEBRAND, op.cit., p. 30
- 18.Ibid., p. 84
- 19.This belief was expressed by one of the owners of the firm during an interview.
- 20.The photograph is from the Catalog of 'Brooks & Doxey Ltd, Makers of Textile Machinery', 1925, p. 253.
- 21.TILMANN BUDDENSIEG, HENNING ROGGE, Peter Behrens and the AEG Architecture, LOTUS 12 International p. 124
- 22.J.WINTER, op.cit., p. 90
- 23.Source: An advertising leaflet of the company
- 24.Source: An advertising leaflet of the company
- 25.COMMERCIAL AND INDUSTRIAL CHAMBER OF GREECE, op.cit., p. 50
26. Source:An advertising leaflet of the company
- 27.Source: The records of the company
- 28.Source: An advertising leaflet of the company
- 29.Owner of PIERAKOS SPINNING MILL (A.3)
- 30.Catalog of 'Brooks & Doxey Ltd, Makers of Textile Machinery', p. 287
- 31.Ibid., p. 305 and 313
- 32.J.P.BONTA, op.cit., p. 124
- 33.The term is borrowed from A.KRIEGER, The Typological Concept, AMERICAN ANTIQUITY, U.S.A., Vol. 9, 1944, p. 272, who referring to the principal attitudes toward the organization and description of archaeological material, distinguishes the 'full-description' approach where specimens are described individually in detail.

1. WEBSTER'S NEW COLLEGIATE DICTIONARY, HÖFMANN'S ETYMOLOGICAL DICTIONARY OF THE GREEK LANGUAGE, and also OXFORD ENGLISH DICTIONARY
2. OXFORD ENGLISH DICTIONARY, vol. XF, T-U, p. 555
3. Ibid., 556
4. A similar view is in H.GLASSIE, Structure and Function, Folklore and Artifact, SEMIOTICA 7/8, 1973, p. 325, when he distinguishes between *ad hoc* classifications and cross-cultural typologies.
5. Concerning the terms 'building class' and 'form type', U.Eco uses the terms functional-sociological type and spatial type respectively in his The Semiotics of Architecture, in G.BROADBENT, R.BUNT, C.JENCKS, 'Signs, Symbols and Architecture', J.Wiley & Sons Ltd., N. York, 1980, pp. 38-39. P. TZONOS in order to denote the same distinction uses the terms 'building class' and 'building type' in his 'Building Typology', (in Greek), Lab. of Architectural Design, Aristotle University of Thessaloniki, Greece, 1979, p. 36. A.COLQUHOUN in his Typology and Design Method, in C.JENCKS & C.BAIRD, 'Meaning in Architecture', The Cresset Press, London, 1969 and B.HILLIER, J.MUSGROVE, P.O'SULLIVAN, Knowledge and Design, EDRA 3, Ed. Mitchell, 1972, use the term 'solution type' to denote the form type.
6. Henceforth the term 'type' will be used instead of the term 'form-type' for brevity
7. VITRUVIUS, 'The Ten Books on Architecture', Dover Publ. Inc. New York, 1965 (Transl. by M.H.Morgan ©1st cent.BC), p.76
8. L.B.ALBERTI, 'Ten Books on Architecture', Book VII, Alec Tiranti Ltd., London, 1955, (Transl. by J.Leoni, © 1726), pp 132-161
9. A.PALLADIO, The Four Books of Architecture, Dover Publ. Inc., New York, 1965 Second Book © 1753), pp. 37-56
10. R.WITTKOWER, 'Architectural Principles in the Age of

11.Ibid., p. 73

12.N.KUHNERT, S.REIB-SCHMIDT, Entwerfen mit Invarianzen und
Vorstellungs buildern Thesen zur rationaler Architektur,
37 ARCH+, Aachen, April 1978, p. 34

13.Ibid., p. 34

14.MARCH-ANTOINE LAUGIER, 'An Essay on Architecture',
Hennessey & Ingalls Inc . Los Angeles, 1977, (Transl.
from 'Essai sur l'Architecture', Paris, © 1753).

15.Ibid., p. 12

16.Goethe's ideas about the archetypal plant are presented
in the following section (4.3)

17.P.STEADMAN, 'The Evolution of Designs: Biological Analogy
in Architecture and the Applied Arts', Cambridge
University Press, Cambridge, 1979, p. 29

18.J.F.BLONDEL, 'Cours d'Architecture ou traité de la
Decoration, Distribution et Construction des Bâtiments
contenant les leçons données eu 1750 et les années
suivantes', Vol. I, Paris 1871-1877, pp. 411-447

19.J.MCMURTIE, 'Cuvier's Animal Kingdom' Orr and Smith,
London (Transl. from the French text by H.McMurtie, MD
CCCXXXIV) p. 23

20.Semper's ideas about the notion of type are given in the
prolegomena of the first volume of his treatise 'Der
Stil in den Technischen und Tectonischen Künsten oder
praktische Aesthetik', Friedr. Bruckmann's Verlag, Munchen
1978, (© 1863). About Semper's work is L.D.ETTLINGER,
On Science, Industry and Art: Some Theories of Gottfried
Semper, ARCHITECTURAL REVIEW, 1964, Vol. 136. pp. 57-60

21.J.N.L.DURAND, 'Leçons d'Architecture. Partie Graphique
des Cours d'Architecture', Paris, 1819

22.VIOLLET LE DUC, 'Dictionnaire Raisonne de l'Architecture

- Francaise', Paris: A Morel Editeur, M DCCCLXVI, Vol. VI, p. 98
- 23.Ibid., Vol. II, p. 324
- 24.Ibid., Vol. VI p. 99
- 25.QUATREMÈRE DE QUINCY, 'Encyclopédie Méthodique d'Architecture', Paris, 1825, Vol. 3, pp. 543-545. Translation of the text referring to 'type', apart from the section covering sculpture, is in A.VILDER, Quatremère's Definition of Type, OPPOSITIONS, 1977, Vol. 8
- 26.QUATREMÈRE DE QUINCY; 'An Essay on the Nature, the End and the Means of Imitation in the Fine Arts' Smith Elder and Co., London, 1837, (Transl. by J.C.Kent from 'Essai sur la nature, le but et les moyens de l'imitation dans les Beaux-Arts', Paris 1823).
- 27.Op.cit., A.VIDLER, p. 148
- 28.Ibid., p. 149
- 29.Op.cit., QUATREMÈRE DE QUINCY, 1837, p. 184
- 30.Op.Cit., A.VIDLER, p. 149
- 31.Ibid., p. 148
- 32.J.N.L.DURAND, op.cit., p. 6
- 33.Ibid., p. 16
- 34.Ibid, planche 20
- 35.J.CAMPBELL, 'The German Werkkbund. The Politics of Reform in the Applied Arts', Princeton University Press, Princeton 1978, p. 56
- 36.H.MUTHESIUS, Propositions, DOCUMENTS, The Open University Press, 1975, p. 5
- 37.HENRY VAN DE VELDE, Counter-Propositions, DOCUMENTS, The Open University Press, 1975, p. 6

38. Details on the discussion included in Extracts from the Werkbund debate, Cologne, DOCUMENTS, The Open University Press, 1975, pp. 8-11
39. LE CORBUSIER, 'Towards a New Architecture', The Architectural Press, London, 1927, p. 210
40. LE CORBUSIER und P. JEANNERET, 'Ihr Gesamtes Werk von 1910-1929', Verlag Dr. H. Girsberger & Cie, Zurich, 1930, p. 15
41. Ibid., p. 16
42. The neorationalist movement appeared on the architectural scene with the writings of the 60's in Italy. It was based on aspects of the original Italian rationalist doctrine of the 20's. The neorationalist ideology is based on the idea that architecture is an autonomous aesthetic discipline. Strongly influenced by structural linguistic studies in France and Italy the Rationalists consider architecture as a process for the formation of a language for the analysis of the morphology of the city. On this subject is M. GALDENSONAS, Neo-functionalism, (Editorial), OPPOSITIONS, 1977, No 8; A. COLQUHOUN, Rational Architecture, A.D., 1975, No 6; and K. KUHNERT, S. REISS-SCHMIDT, op.cit.
43. G.C. Argan introduced his ideas on typology in his book 'Progetto e Destino', Il Saggiatore, Milano, 1965, chapter two on 'Sul concetto di tipologia architettonica'.
44. Ibid., p. 77
45. A. ROSSI, 'The Architecture of the City', MIT Press, London, 1982, (Transl. from L'Architettura della Citta, by D. Chirardo & J. Ockman, Marsilio Editori, Padua, © 1966)
46. Ibid., p. 22
47. Ibid., p. 41

- 48.A.ROSSI, 'A Scientific Autobiography', MIT Press,
London, 1981, p. 20
- 49.An interesting comparison between the theoretical
position of A.Rossi and his design work is in R.MONEO
Aldo Rossi: The Idea of Architecture and the Modena
Cemetery, OPPOSITIONS, 1977, No 8
- 50.ALDO ROSSI, 'Selected Writings and Projects', Architec-
tural Design, London-Gandon Editions, Dublin, 1983, p.11
- 51.The rational and poetic aspect of A.Rossi's work is
analysed by Sheila O'Donnell in the introduction of
Ibid.
- 52.R.KRIER, 'Urban Space', Academy Editions, London, 1975
- 53.This book has not yet printed but part of it has been
published in the A.D., Profile, 9/10, 1983
- 54.Ibid., p. 38
- 55.Ibid., p. 42
- 56.GOTTFRIED SEMPER, op.cit. His work includes two volumes
devoted entirely to decoration and craft work. According
to Semper architecture, applied arts, and crafts have
common genetic laws and have never existed in isolation
from each other. Thus, a third volume, which was never
completed, was intended to cover the subject of architecture.
- 57.Ibid., p. VII. The translation of the text is cited in
W.LINDNER & G.STEINMETZ, Engineering and Aesthetics,
DOCUMENTS, The Open University Press, 1975, pp. 57-59
- 58.JOSEPH RYKWERT, Gottfried Semper and the Problem of
Style, A.D.51, 6/7, 1981, pp. 13-14. It is an interesting
analysis of G.Semper's theory of style presented in his
'Der Stil' under the influence of Cuvier's theory. Another
approach to the ideas of Semper which revealed through
the whole of his work is written by P.STEADMAN, op.cit.,
mainly in pages 64-73

59. GEORGE KUBLER, 'The Shape of Time: Remarks on the History of Things', N.Haven and London, Yale University Press, 1961, p. 13
60. Ibid., pp 32-33
61. Ibid., p. 50
62. A short revision of his treatise is presented in the article G.KUBLER, The Shape of Time-Reconsidered, PERSPECTA, Vol. 19, 1982, pp. 112-121. Two important reviews criticize Kubler's view. One is written by PRISCILLA COLT in ART JOURNAL 23, No 1, 1963, pp. 78-79 and the other by JAN BIALOSTOCKI in the ART BULLETIN, 46, No 1, 1965, pp. 135-139
63. P.STEADMAN, op.cit., p. 228
64. M.TAFURI, 'Theories and History of Architecture', Granada, London, Toronto, Sydney, N.York, 1980 (© 1976), p. 163
65. Ibid., p. 159.
66. A.COLQUHOUN, op.cit., p. 273
67. B. Hillier *et al*, op. cit., p. 8
68. Ibid., p. 29-3-16
69. D.PORPHYRIOS, 'Sources of Modern Eclecticism. Studies on Alvar Aalto', Academy Editions, London, 1982
70. Ibid., p. 33
71. Ibid., p. 34
72. Cited in Ibid., p. 25
73. Ibid., p. 26
74. K.FRAMPTON, 'Modern Architecture. A Critical History' Thames and Hudson, Ltd, London, 1980, pp. 192-193
75. P.TZONOS, op.cit., pp 36-45

76.Ibid., p. 8

77.P.TZONOS, 'Typology of Housing', (in Greek), Thessaloniki, 1983

78.R.W.BRUNSKILL, 'Illustrated Handbook of Vernacular Architecture', Faber and Faber, London, 1971

79.In the case of R.W.Brunskill, the types are 'The first floor family; The hall family; The two-unit family; Inside cross passage family and the double pile plan'. In the case of F.RAGETTE, 'Architecture in Lebanon', American University of Beirut, Beirut, 1974, the types are 'The close rectangular house; The Gallery house; The Liwan house and related court houses; The central hall house, and the combination types'

80.This term is borrowed from A.KRIEGER, op.cit., He uses this term in order to distinguish the typological methods from the pure descriptive and classificatory ones.

81.An analysis of the evolution of taxonomic methods is presented in D.KNIGHT, 'Ordering the World. A History of Classifying Man', Burnett Books - A.Deutsch, London, 1981, and also M.FOUCAULT, 'The Order of Things', Tavistock Publ. Ltd., London, 1970 (Transl. from 'Les Mots et les Choses', Editions Gallimard, Paris, © 1966).

82.This term is borrowed from C.G.HEMPEL, Taxonomy, in C.G. HEMPEL (ed.), 'Aspects of Scientific Explanation and other Essays in the Philosophy of Science', The free Press, N.Y., 1964, pp. 139-140. He claims that the development of a scientific discipline proceeds from an initial 'natural history' stage which primarily seeks to describe the phenomena under study and to establish simple empirical generalizations concerning them to subsequent more and more theoretical stages.

83.T.S.KUHN, 'The Structure of Scientific Revolutions', The University of Chicago Press Ltd, London, 1979, (© 1962)

- 84.J.B.LAMARCH, 'Zoological Philosophy. An Exposition with Regards to Natural History of Animals', (Transl. with an introduction by H.Elliot, Paris, ©1804), Macmillan and Co, Ltd., London, 1914, p. 19
- 85.Natural classifications should be viewed as having objective existence in nature, whereas, artificial classifications do not, and also in this case the defining characteristics have few explanatory and predictive connections with other traits. From C.G.HEMPEL, op.cit., pp. 146-147
- 86.J.W.v.GOETHE, 'The Metamorphosis of Plants', Dynamic Literature, Wyoming, Rhode Island 02898, p. 13
- 87.J.W.v.GOETHE, 'Versuch die Metamorphose der Pflanzen zu Erklären', Gotta, 1790, (Transl. with commentary by A. Arber), CHRONICA BOTANICA, 10:2 (1946), p. 81
- 88.D.L.CLARKE, 'Analytical Archaeology', Methuen & Co Ltd., London, 1978, p. 21
- 89, Ibid., p. 197
- 90.J.N.HILL and R.K.EVANS, A Model for Classification and Typology from 'Models in Archaeology', ed. D.L.CLARKE, Methuen & Co. Ltd, 1972
- 91.A.KRIEGER, op.cit.
- 92.Ibid., p. 277
- 93.Ibid., p. 272
- 94.Ibid., p. 277
- 95.Ibid., p. 278
- 96.V.G.CHILDE, 'Piecing Together the Past. The Interpretation of Archaeological Data', Routledge & Kegan Paul, London, 1956, p. 8
- 97.R.MONEO analyses his view in the article On typology OPPOSITIONS, No 13, Summer, 1978

- 99.D.N.MARONITIS, Definitions and Limits in his 'Definitions of Lyricism in Odysseas Elitis', (in Greek), Athens, Kedros, 1980, p. 55
- 100.Ibid., p. 56
- 101.ENCYCLOPAEDIA BRITTANICA: Macropaedia, 15th Edition 1981 Printing, Vol. 2, under the heading 'Arts, Style in the', p. 123
- 102.Ibid., p. 123
- 103.JAMES S.ACKERMAN, A Theory of Style, JOURNAL OF AESTHETICS AND ART CRITICISM, 20, 1962, p. 227
- 104.MEYER SCHAPIRO, Style, in A.L.CROEBER (Editor) 'Anthropology Today', The University of Chicago Press, Chicago-Illinois, 1953, p. 287
- 105.CHRISTIAN NORBERG-SCHULZ, 'Intentions in Architecture', MIT Press, Massachussets, Cambridge, 1965, p. 156

CHAPTER V

1. J.N.C.DURAND, op.cit.
2. P.FRANKL, op.cit.
3. C.NORBERG-SCHULZ, 'Genius Loci', Academy Editions, London 1980, p. 177
4. Ibid., p. 177
5. Topological relations are those involving concepts like proximity, separation, order and enclosure, whereas geometrical relations are purely euclidean. The two kinds of spatial relations have been analysed by C. NORBERG-SCHULZ, 1965, op.cit., pp. 140-146, based on J.PIAGET and B.INHELDER, 'The Child's Conception of Space', Routledge & Kegan Paul, London 1956, (First Publ. in France in 1948) and the principles of Gestalt theory.

6. The term 'mean-type' is borrowed from D.L. CLARKE, 1978, op.cit., pp. 191-192 who discusses the legitimacy and danger of using this sort of 'average' types in archaeological analysis.

CHAPTER VI

1. WILLIAM J.R. CURTIS, 'Modern Architecture since 1900', Phaidon, Oxford, 1982, pp. 14-15
2. H.A.N. BROCKMAN 'The British Architect in Industry: 1841-1940', George Allen & Unwin Ltd, London 1974, pp. 17-20
3. J.M. RICHARDS, 'The Functional Tradition in Early Industrial Buildings', The Architectural Press, London, 1958, p. 84
4. H.A. BROCKMAN, op.cit., p. 19
5. J.M. RICHARDS, op.cit., p. 88
6. The criterion for distinguishing the technological revolutions is the kind of technology which is used in the productive process. For instance, the second technological revolution is characterized by the generalized application of electric, and combustion engines in all branches of industry, whereas in the first technological revolution the principal prime mover is the machine-made steam engine. Industrial revolution is distinguished from the technological revolutions because it conditioned the transition from feudalism to capitalism. Cited in E. MANDEL, 'Late Capitalism', Verso Edition, London, 1978, pp. 120-121
7. Source: P. DAVAKIS, B. PIMENIDIS, 'Cultural Centre in an old warehouse of Xanthi', Diploma Thesis, Dept. of Architecture Aristotle University of Thessaloniki, Feb. 1986
8. H.A. BROCKMAN, op.cit., p. 16
9. The first school of civil engineers was established in 1887 as part of the so-called *Ecoles d'arts industrielles*. Cited in A. VOURNAZOU, History of the Establishment of

Technical University of Athens, (in Greek) TECHNICA
CHRONICA, 1934, pp 59-60

10. Vitaliano Poselli was an Italian architect who prevailed in the architectural scene of the city of Thessaloniki from 1870 to 1910. A brief and rather photographic presentation of his work is V.KOLONAS, L.PAPAMATHEAKI, 'The Architect Vitaliano Poselli: His Work in Thessaloniki', (in Greek) Paratiritis, Thessaloniki, 1980
11. A comprehensive work on the German Neoclassicism and its echo on Greek architecture is the doctoral thesis submitted by C.SKARPIA-HEUPEL in 1976 in the Aristotle University of Thessaloniki with the topic 'The Morphology of the German Neoclassicism (1789-1848) and its Creative Assimilation by Greek Architecture (1833-1897)
12. G.TSAROUCHIS, The Importance of Neoclassical Architecture and the Attitude of Modern Architecture towards it, (in Greek), ARCHITECTURAL STUDIES, No 1, Athens, 1966, p. 50. Cited in G.SARIGIANNIS, The Architecture in Greece and the Architectural Studies in Athens Technical University, (in Greek), TECHNICA CHRONICA, Jul. Aug. Sep., 1977, p. 70
13. K.BIRIS, Greek Artistic Movement, One Hundred Years of Athenian Architects, (in Greek), TECHNICA CHRONICA, 1 Mar. 1939, p. 181
14. G.SARIGIANNIS, op.cit., p. 70
15. HERMAN MUTHESIUS, 'Das Form-Problem im Ingenieurbau', in Die Kunst in Industrie und Handel, Jahrbuch des Deutschen Werkbundes, Jena. 1913, Seite 23-22. Cited in H.STURM 'Fabrikarchitektur, Villa, Arbeitersiedlung' Heinz Moos Verlag, München, 1977, pp. 222-224 (particular reference in page 222).
16. SEBASTIAN MÜLLER, 'Kunst und Industrie', 1974, p. 52, cited in H.STURM, op.cit., p. 92
17. H.A.N.BROCKMAN, op.cit., p. 91
18. Ibid., p. 135

19.H.STURM, op.cit., p. 85

20.Ibid., p. 90

21.TILMANN BUDDENSIEG-HENNING ROGGE, op.cit., p. 120

22.Ibid., p. 93

23.The first is the building of ATTICA SPINNING MILLS which when initially constructed belonged to the 'Hellenic Wool Industry' owned by Bodosakis, one of the barons of Greek Industry. The second is FOUSTANOS' mill, which does not belong to the sample. The owner was a very rich industrialist from the island of Syros.

24.J.M.RICHARDS, op.cit., p. 87

25.L.GRENER, H.WIESER-BENEDETTI, op.cit., p. 123

26.Ibid., p. 137

27.G.CHRISTOPOULOS, op.cit., p. 129

28.The term 'architecture' refers here only to buildings designed by architects and does not include the anonymous builder's constructions.

29.The articles which express the first of the two trends are: B.KASSANDRAS, Thoughts about modern architectural trends, (in Greek), TECHNICA CHRONICA, 15 Nov-1 Dec. 1934, pp. 1025-1030, K.BIRIS, The new architecture and some of its applications, (in Greek), TECHNICA CHRONICA, 15 Nov-1 Dec. 1934, pp. 1030-1033, and K.BIRIS, About some of the misunderstandings of architecture, (in Greek), TECHNICA CHRONICA, 15 May-15 June, 1935, pp. 537-538. The other trend is revealed through the article of P.KARANTINOS, About the new architecture, (in Greek), TECHNICA CHRONICA, 15 Mar. 1935, pp. 340-346

30.B.KASSANDRAS, op.cit., pp. 1028-1029

31.K.KITSIKIS, Trends of Modern Architecture, (in Greek), TECHNICA CHRONICA, 15 May-1 June, 1949, p. 412

32. The only buildings which absorbed the majority of the architects' activity and express their rationalist ideas were the public schools which were erected in many parts of the country according to a programme for educational reform introduced between 1922 and 1924 and also from 1930 to 1935. An analysis of the work of those pioneering architects can be found in A. GIACUMACATOS, *op.cit.*, pp. 75-92, and in S. AMOURGIS, *Greek Architecture of the Twenties and Thirties*, (in Greek with English Summary), *ARCHITECTURE IN GREECE*, No 1/1979, pp. 146-149
33. Especially L. 3741/1929 about 'The horizontal property' which lead after the War to land speculation by entrepreneurs with small capital.
34. The analysis of the topics in 'Guide of Studies', (in Greek), Technical University of Athens, Academic Year 1950-1951. Vice President G.N. KORONEOS, Athens 31 Dec. 1959, p. 100
35. Between 1945-50 only 20 architects and 100 civil engineers graduated, whereas between 1955-60 155 architects compared with 472 engineers. Source: NATIONAL STATISTICAL SERVICE OF GREECE.
36. An analysis of the trends in modern Greek architecture as a dialectic between modernism and tradition, and also a presentation of the work of representative architects of the two ideological lines are given in A.K. ANTONIADIS, 'Modern Greek Architecture', (in Greek), Anthopos and Choros, Athens, 1979-D. PHILIPPIDIS, 'Modern Architecture', (in Greek), Melissa, Athens, 1984
37. J.F. MUNCE in his book 'Industrial Architecture: An Analysis of International Building Practice', F.W. Dodge Corporation, N.Y., 1960, analyses, though not from the architect's point of view, the different concept of design and the general philosophy behind the factory design in Britain, Germany and USA.

38. WALTER GROPIUS, 'Die Entwicklung modernes Industrie-baukunst', in Die Kunst in Industrie und Handel, Jahrbuch des Deutschen Werkbundes, Jena 1913, p. 17-22. Cited in the Quellentexte of H. STURM op.cit., pp. 225-226
39. There are two works dealing with this topic. The first under the title 'Notes on the Character and Evolution of the Architectural Studies in the School of Technology of Thessaloniki', (in Greek) is presented by a group (DI.SI. A.) in the 6th Greek Architectural Congress, and is published in TECHNICA CHRONICA. The second is an extensive student research work: B. ZOGRAFOS, A. GIANNAKOU, 'Architectural Education: An Attempt to Record the Elements of its Content in the Architectural Department of the University of Thessaloniki in the period 1958-1978', (in Greek), Chair of Architectural Design, Prof. P. TZONOS, Thessaloniki, 1979
40. The 'Design Methods' which prevailed in the architectural debate in Europe and the United States in the 1960's together with the various scientific borrowings, signify the scientific era of architectural thinking. This trend was transplanted in Greece and affected the character of architectural studies.
41. There are two publications which are for the use of students, and analyse all the important aspects of industrial building design: D. A. FATOUROS, 'Lessons on a Systematic Theory of Architecture: Vol. 3. Notes on Factories and Exhibition Halls', (in Greek), School of Technology, Thessaloniki, 1973, p. 85, and 'Lessons of Architectural Design: Vol. 1, Industrial Premises', (in Greek), Chair of Architectural Design, Prof. I. D. Triantafillidis, Thessaloniki, 1977, p. 637. The second publication is a broad and comprehensive approach to factory design despite the fact that it is based only on foreign buildings.
42. S. ALOI, 'Architecture Industriale Contemporanee' Ulrico Hoepli, Milano, 1966, O. GRUBE, op.cit., J. WINTER op.cit.,

FRIEDMAN WILD, 'Design and Planning: Factories', Van Nostrand Reinhold Company, N. York 1972, Special issues of AA 133/1967, B+W/8/1972, TECHNIQUES & ARCHITECTURE USINES: ARCHITECTURE ET CONDITIONS DE TRAVAIL, Mai 1977, No 314

CHAPTER VII

1. This term was used by GEOFFREY SCOTT in 'The Architecture of Humanism', Methuen & Co Ltd, London, 1914, pp. 165-185, and more recently by P.STEADMAN, op.cit., p. 180 to denote the misleading belief that the historical evolution of buildings is analogous to the evolution of natural organisms.
2. D.PHILLIPIDIS, op.cit., p. 277
3. Ibid., p. 369
4. W.J.R.CURTIS, op.cit., p. 97
5. L.BENEVOLO, 'History of Modern Architecture', Vol. 2, Routledge & Kegan Paul, London, 1960, p. 409
6. V.KOLONAS, L.PAPAMATHEAKI, op.cit., p. 42
7. Ibid., p. 123
8. The relationship between the evolution of human culture and the evolution of organisms, which underlines the distinction between form types in architecture and biological types, is analysed by P.STEADMAN in parallel with the theories of Darwin and Lamarch, Op.cit., chapters 8, 13 and 14
9. R.MONEO, op.cit., p. 28
10. B.HILLIER *et al*, op.cit., refer to them as 'solution types' which constitute an important factor of the determinants of design

11.R.MONEO, op.cit., p. 24

12.A.COLQUHOUN argues on the two different views of history on which architectural theory has always been based implicitly: the 'normative' and the 'relativist'. The former sees history as a repository of permanent values which are transferred from one generation to the next, whereas the latter believes that history is a process of continuous evolution, where the systems of cultural value have a relative truth. Both views are analysed in his 'Introduction: Modern Architecture and Historicity', from ALAN COLQUHOUN, 'Essays in Architectural Criticism: Modern Architecture and Historical Change', MIT Press, London, 1981, pp. 11-19

GENERAL CONCLUSIONS

1. G.KUBLER, op.cit., p. 67

BIBLIOGRAPHY

- AA 133/1967
- J.S.ACKERMAN, A theory of Style, JOURNAL OF AESTHETICS AND ART CRITICISM, 20, 1962
- A.D., Profile, 9/10, 1983
- J.B.AITKEN, 'Automatic Weaving', Columbre Press, Manchester & London, 1964
- L.B.ALBERTI, Ten Books on Architecture, Book VII, Alec Tiranti Ltd., London, 1955, (Transl. by J.Leoni, © 1726).
- S.ALOI, 'Architetture Industriali Contemporanee', Ulrico Hoepli, Milano, 1966
- S.AMOURGIS, Greek Architecture of the Twenties and Thirties, (in Greek with English Summary), ARCHITECTURE IN GREECE, No 1/1979
- I.ANGELOPOULOS, Building of A.Afentouli, (in Greek), ARCHIMIDIS, No 11, Mar. 1907
- E.ANDRIKOPOULOU-KAFKALA, 'State Intervention and Regions: The Disposition of Regional Space in Greece', (in Greek), Doctoral Thesis, Aristotle University of Thessaloniki, 1984
- A.K.ANTONIADIS, Modern Greek Architecture, (in Greek), Anthropos and Choros, Athens 1979
- ARCHIMIDIS, 'Description of an excursion in the Hellenic Factory of Cement of Hadjikirikiakos, Zacharias and Co', Report, No 2, June 1906
- ARCHITECTURE IN GREECE, 16/1982
- G.C.ARGAN, 'Progetto e Destino', Il Saggiatore, Milano, 1965
- S.ARGIROU, I.CHASID, A.KOUVAS, I.AIVAZIS, 'Branch Study for the Textile Industry in the Framework of the 5-year Programme', (in Greek), (unpublished).
- S.BABANASIS, K.SOULAS, 'Greece in the Periphery of the Developed Countries', (in Greek), Ed. Themelio, Athens, 1976

- L.BENEVOLO, 'History of Modern Architecture', Vol. 2, Routledge & Kegan Paul, London 1960
- J. BIALOSTOCKI, Review of G.Kubler's book 'The Shape of Time', in ART BULLETIN, 46, No 1, 1962
- K.BIRIS, The new architecture and some of its applications, (in Greek), TECHNICA CHRONICA, 15 Nov-1 Dec. 1934
- K.BIRIS, About some of the misunderstandings of architecture (in Greek), TECHNICA CHRONICA, 15 May-15 June, 1935
- K.BIRIS, Greek Artistic Movement. One Hundred Years of Athenian Architects, (in Greek), TECHNICA CHRONICA, 1 Mar. 1939
- K.BIRIS, 'The Athens of Nineteenth and Twentieth Century', (in Greek), Athens, 1966
- J.F.BLONDEL, 'Cours d'Architecture ou traité de la Decoration, Distribution et Construction des Bâtiments contenant les leçons données eu 1750 et les années suivantes', Vol.I, Paris, 1871-1877
- J.P.BONTA, 'Architecture and its Interpretation', Lund Humphries Publ. Ltd., London, 1979
- G.K.BOON, 'Technology Transfer in Fibres, Textile and Apparel', Sijthoff & Noordhoff, Alphen aan den Rijn, The Netherlands, Rockville, Maryland, USA 1981
- M.BOURDERIOUX, 'Les Ambiances de Travail dans l'Industrie Textile', Caisse Régionale D' Assurance Maladie de Nord de la France, 11 Boulevard Vauban, Lille, 16 Oct., 1975
- H.A.N.BROCKMAN, 'The British Architect in Industry: 1841-1940', George Allen & Unwin Ltd, London 1974
- 'BROOKS & DOXEY Ltd Makers of Textile Machinery', Catalog of the firm, 1925
- R.W.BRUNSKILL, 'Illustrated Handbook of Vernacular Architecture', Faber and Faber, London 1971
- T.BUDDENSIEG, H.ROGGE, Peter Behrens and the AEG Architecture, LOTUS 12 International
- B+W/8/1972

- J.CAMPBELL, 'The German Werkbund The Politics of Reform in the Applied Arts', Princeton University Press, Princeton 1978
- CENTRE OF ECONOMIC PLANNING AND RESEARCH, 'Development Programme 1976-80: Textile Industry-Clothing', (in Greek) Report of Team Work No 9
- V.G.CHILDE, 'Piecing Together the Past. The Interpretation of Archaeological Data', Routledge & Kegan Paul, London, 1956
- G.CHRISTOPOULOS, 'Thessaloniki During the Last Hundred Years', (in Greek), Enosis, Thessaloniki, 1936
- D.L.CLARKE, 'Analytical Archaeology', Methuen & Co Ltd., London, 1978
- A.COLQUHOUN, Typology and Design Method in C.JENCKS & C.BAIRD, 'Meaning in Architecture', The Cresset Press, London 1969
- A.COLQUHOUN, Rational Architecture, A.D., 1975, No 6
- A.COLQUHOUN, 'Essays in Architectural Criticism: Modern Architecture and Historical Change', MIT Press, London, 1981
- P.COLT, Review of G.KUBLER'S book in 'The Shape of Time', in ART JOURNAL 23, No 1, 1963
- T.A.COULOUMBIS, J.A.PETROPOULOS, H.J.PSOMIADIS, 'Foreign Interference in Greek Politics: A Historical Perspective', Pella Publ. Co, N.Y., 1976
- G.COUTSOUMARIS, 'The Morphology of Greek Industry', Centre of Economic Research, Athens, 1963
- COMMERCIAL AND INDUSTRIAL CHAMBER OF GREECE, 'D.Hadjopoulos', Thessaloniki
- COMMERCIAL BANK OF GREECE, 'The Greek Textile Industry', (in Greek), Publ. of the Dept. of Economic Studies, Branch Studies No 5, Athens 1981
- LE CORBUSIER, 'Towards a New Architecture', The Architectural Press, London, 1927
- LE CORBUSIER, und P.JEANNERET, 'Ihr Gesamtes Werk von 1910-1929', Verlag Dr. H.Girsberger & Cie, Zurich, 1930
- W.J.R.CURTIS, 'Modern Architecture since 1900', Phaidon, Oxford, 1982

- DEMATHAS, About the Industrial Development of Greece, (in Greek), ATTICA CALENDAR, 1877
- DI.SI.A., 'Notes on the Character and Evolution of the Architectural Studies in the School of Technology of Thessaloniki, (in Greek), Presented in the 6th Architectural Congress, publ. in TECHNICA CHRONICA
- J.DRURY, 'Factories: Planning, Design and Modernization', The Architectural Press, London, 1981
- J.N.L.DURAND, 'Leçons d'Architecture. Partie Graphique des Cours d'Architecture', Paris, 1819
- U.ECO, 'The Semiotics of Architecture, in G.BROADBENT, R. BUNT, C.JENCKS, 'Signs, Symbols and Architecture', J.Wiley & Sons Ltd., N.York, 1980
- E.LE.MEP, The Future of Greek Industry and the Role of Workers , (in Greek), paper presented in the Symposium on 'Industry in Greece' organized by the Technical Chamber of Greece (Feb. 1981), published in SYCHRONA THEMATA, No 11, Jul. 1981
- H.S.ELLIS, in collaboration with D.D.PSILOS, P.W.WESTEBBE and C.NICOLAOU, 'Industrial Capital in Greek Development', Centre of Economic Research, Research Monograph Series 8, Athens, 1964
- ENCYCLOPAEDIA BRITANNICA: Macropaedia, 15th Edition 1981 Printing, Vol. 2, under the heading 'Arts, Style in the', p. 123
- L.D.ETTLINGER, On Science, Industry and Art: Some Theories of Gottfried Semper, ARCHITECTURAL REVIEW, 1964, Vol. 136
- D.A.FATOUROS, 'Lessons on a Systematic Theory of Architecture: Vol. 3. Notes on Factories and Exhibition Halls', (in Greek), School of Technology, Thessaloniki, 1973
- K.FRAMPTON, 'Modern Architecture. A Critical History', Thames and Hudson, Ltd., London, 1980
- P.FRANKL, 'Principles of Architectural History: The Four Phases of Architectural Style, 1420-1900', MIT Press, London, 1968 (transl. and Ed. by J.F.O' Gorman. Originally publ. in Germany in 1914)
- T.FOTOPOULOS, Dependent Development and Industrialization, (in Greek), in S.PAPASPILIOPOULOS (ed) 'Studies

on Contemporary Greek Economy', Papazisis, Athens
1978

- M.FOUCAULT, 'The Order of Things', Tavistock Publ. Ltd.,
London, 1970 (Transl. from 'Les Mots et les
Choses', Editions Gallimard, Paris, © 1966)
- M.GALDENSONAS, Neofunctionalism, (Editorial) OPPOSITIONS,
1977, No 8
- A.S.GIACUMACATOS, European Rationalism and Greek Archi-
tecture during the Period between the Wars. A
Critical Review of the Autochthonous Architectural
Production, (in Greek and English Summary),
ARCHITECTURE IN GREECE No 16, 1982
- H.GLASSIE, Structure and Function, Folklore and Artifact,
SEMIOTICA 7/8, 1973,
- J.W.v.GOETHE, 'Versuch die Metamorphose der Pflanzen zu
Erklären', Gotta, 1790, (Transl. with commentary
by A. Arber) CHRONICA BOTANICA, 10:2 (1946)
- J.W.v.GOETHE, 'The Metamorphosis of Plants', Dynamic
Literature, Wyoming, Rhode Island 02898
- B.C.GOSWAMI, J.G.MARTINDALE, F.L.SCARDINO, 'Textile Yarns:
Technology, Structure and Applications', John
Willey & Sons, N.Y. 1977
- L.GRENIER, H.WIESER-BENEDETTI, 'Les Châteaux de l'Industrie:
Recherches sur l'architecture de la région Lilloise
de 1830 à 1930', Tome II Edité par les Archives d'
architecture Moderne et le Ministère de l'Environ-
nement et du Cadre de Vie-Direction de l'architec-
ture, Paris-Bruxelles, 1979
- L.GRIVEAUD, 'Traité Pratique de Construction et Aménagement
des Usines', Librairie Polytechnique Ch.Béranger,
Paris, Liège, 1951
- W.GROPIUS, 'Die Entwicklung modernes Industriebaukunst ',
in Die Kunst in Industrie und Handel, Jahrbuch
des Deutschen Werkbundes, Jena 1913, Cited in the
Quellentexte of H.STURM
- O.GRUBE, 'Industrial Buildings and Factories', The Archi-
tectural Press, London, 1971
- G.HARITAKIS, 'The Greek Industry: Industry, Mining, Labour',
(in Greek), Estia, Athens, 1927

- C.G.HEMPEL, Taxonomy, in G.C.HEMPEL (ed.), Aspects of Scientific Explanation and other Essays in the Philosophy of Science', The Free Press, N.Y., 1964
- G.HILDEBRAND, 'Designing for Industry', MIT Press, London, 1974
- J.N.HILL and R.K.EVANS, A Model for Classification and Typology from 'Models in Archaeology', ed. D. L.CLARKE, Methuen & Co. Ltd., 1972
- B.HILLIER, J.MUSGROVE, P.O'SULLIVAN, Knowledge and Design, EDRA 3, Ed. Mitchell, 1972
- HMS O , 'Cotton and Allied Fibres, Health and Safety 1971-1977
- HÖFFMANN'S ETYMOLOGICAL DICTIONARY OF THE GREEK LANGUAGE
- ICAP, 'Financial Directory of Greek Companies', Athens, 1982
- INSTITUTE OF ECONOMIC AND INDUSTRIAL RESEARCH, 'Greek Textile Industry and EEC', (in Greek), Athens, 1978
- INTERNATIONAL LABOUR OFFICE, 'Blanchard Report', Athens, September 1978
- INTERNATIONAL LABOUR OFFICE, 'Encyclopaedia of Occupational Health and Safety', Technical Editor: Dr. Luigi Parmeggiani, Two Volumes, Geneva, 1983
- INTERNATIONAL LABOUR ORGANIZATION, 'Safety and Health in the Textile Industry', Textiles Committee, Nineth Session, Geneva, 1973
- P.KABOUROGLOU, 'History of Piraeus from 1833-1882', (in Greek), Publ. Asmodeos, Athens, 1883
- G.KAFKALAS, 'Regional Organization of Industry: Completion and Restructuring of the Decade 1969-1978' (in Greek), Doctoral Thesis, Aristotle University of Thessaloniki, 1984
- D.KALIVAS, About the Reinforced Concrete, or composite structures , (in Greek) ARCHIMIDIS No 12, Apr 1907 and No 1 & No 2 May & Jun 1908
- A.KARTOS, 'Syros', (in Greek), Publ. Melissa, Athens 1982

- P.KARANTINOS, About the new architecture, (in Greek),
TECHNICA CHRONICA, 15 Mar. 1935
- B.KASSANDRAS, Thoughts about modern architectural trends,
(in Greek), TECHNICA CHRONICA, 15 Nov-1 Dec. 1934
- B.KASSANDRAS, Ernestos Tsiler, (in Greek), TECHNICA
CHRONICA, Feb. 1939
- A.A.KINTIS, The Post-War Industrial Policy, (in Greek),
ECONOMICOS TACHIDROMOS, 28.1.1982
- K.KITSIKIS, Trends of Modern Architecture, (in Greek),
TECHNICA CHRONICA, 15 May-1 Jun, 1940
- D.KNIGHT, 'Ordering the World. A History of Classifying
Man', Burnett Books - A.Deutsch, London, 1981
- V.KOLONAS, L.PAPAMATHEAKI, 'The Architect Vitaliano
Poselli: His Work is Thessaloniki' (in Greek)
Paratiritis, Thessaloniki, 1980
- S.KONTARATOS, From Traditional to Modern Materials: The
Designer must be a Creator and not simply a
Consumer, (in Greek), ECONOMICOS TACHIDROMOS, No
1054, 4 July, 1974
- G.KORDATOS, 'Introduction to the History of Greek
Capitalism', (in Greek), Epikerotita, Athens, 1930
- A.KRIEGER, The Typological Concept, AMERICAN ANTIQUITY,
U.S.A., Vol. 9, 1944
- R.KRIER, 'Urban Space', Academy Editions, London, 1975
- R.KRIER, Elements of Architecture, A.D. 53,9/10,1983
- G.KUBLER, 'The Shape of Time: Remarks on the History of
Things', N.Haven and London, Yale University
Press, 1961
- G.KUBLER, The Shape of Time-Reconsidered PERSPECTA, Vol.
19, 1982
- T.S.KUHN, 'The Structure of Scientific Revolutions',
The University of Chicago Press Ltd., London,
1970, (© 1962)
- N.KUHNERT, S.REIB-SCHMIDT, Entwerfen mit Invarianzen und
Vorstellungs buildern Thesen zur rationaler Archi-
tektur, 37 ARCH+, Aachen, April 1978

- J.B.LAMARCH, 'Zoological Philosophy. An Exposition with Regards to Natural History of Animals', (Transl. with an introduction by H.Elliot, Paris, ©1804), MacMillan and Co, Ltd., London 1914
- M-A. LAUGIER, 'An Essay on Architecture', Hennessey & Ingalls Inc. Los Angeles, 1977, (Transl. from 'Essai sur l'Architecture', Paris, 1753)
- G.LEFKADITIS, The Importance of Lighting in Industry (in Greek), ERGA, No 111, 15 Jan 1930
- W.LINDNER & G.STEINMETZ, Engineering and Aesthetics, DOCUMENTS, The Open University Press, 1975
- F.LOYER, A Critique of Contemporary Greek Architecture, (in Greek with English extensive Summary), ARCHITECTURE IN GREECE, No 2, 1968
- S.LOVERDOS, 'The National Health', (in Greek), Athens, 1902
- E.MANDEL, 'Late Capitalism', Verso Edition, London, 1978
- D.N.MARONITIS, Definitions and Limits in his 'Definitions of Lyricism in Odysseas Elitis', (in Greek), Athens, Kedros, 1980
- J.MCMURTIE, 'Cuvier's Animal Kingdom' Orr and Smith, London, (Transl. from the French text by H. McMurtie, MD CCCXXXIV)
- E.G.MEARS, 'Greece Today: The Aftermath of the Refugee Impact', Stanford University Press-Oxford University Press, MD CCCXXXIV)
- MINISTRY OF NATIONAL ECONOMY, Report on Greek Industry, (in Greek) part of which was published in ERGA, No 152, 30 Sept. 1931
- R.MONEO, Aldo Rossi: The Idea of Architecture and the Modena Cemetery, OPPOSITIONS, 1977, No 8
- R.MONEO, 'On Typology', OPPOSITIONS, No 13, Summer, 1978
- N.P.MOUZELIS, 'Modern Greece: Facets of Underdevelopment', MacMillan Press, Ltd., London, 1978
- S.MÜLLER, 'Kunst und Industrie', 1974, p. 52, cited in H.STURM
- J.F.MUNCE in his book 'Industrial Architecture: An Analysis of International Building Practice', F.W. Dodge Corporation, N.Y., 1960

- H.MUTHESEIUS, 'Das Form-Problem im Ingenieurbau', in Die Kunst in Industrie und Handel, Jahrbuch des Deutschen Werkbundes, Jena. 1913
- H.MUTHESEIUS, Propositions, DOCUMENTS, The Open University Press, 1975
- L.NIKOLAIDIS, The Effort for Industrialization was founded on the Programme of 1948, (in Greek), ECONOMICOS TACHIDROMOS, 9 Dec. 1971
- C.NORBERG-SCHULZ, 'Intentions in Architecture', MIT Press, Massachussets, Cambridge, 1965
- C.NORBERG SCHULZ, 'Genius Loci', Academic Editions, London, 1980
- OXFORD ENGLISH DICTIONARY
- A.PALLADIO, The Four Books of Architecture, Dover Publ. Inc., New York, 1965 Second Book,(©)
- D.PHILIPPIDIS, 'Modern Architecture', (in Greek), Melissa, Athens, 1984
- J.PIAGET and B.INHELDER, 'The Child's Conception of Space', Routledge & Keagan Paul, London 1956, (First Publ. in France in 1948)
- D.PORPHYRIOS, Classicism is not a style, A.D. 5/6, 1982
- D.PORPHYRIOS, 'Sources of Modern Eclecticism, Studies on Alvar Aalto', Academy Editions, London, 1982
- G.PSOUNIS, The Engineers and the Technical Chamber of Greece, (in Greek), INFORMATION BULLETIN, 1000, 3.6.78
- QUATREMÈRE DE QUINCY, 'Encyclopédie Méthodique d' Architecture', Paris, 1825,, Vol. 3
- QUATREMÈRE DE QUINCY, 'An Essay on the Nature, the End and the Means of Imitation in the Fine Arts', Smith Elder & Co., London, 1837, (Transl. by J.C.Kent from 'Essai sur la nature, le but et les moyens de l'imitation dans les Beaux-Arts', Paris 1823).
- F.RAGETTE, 'Architecture in Lebanon', American University of Beirut, Beirut, 1974

- K.REID (ed), 'Industrial Buildings: The Architectural Record of a Decade', Publ. F.W.Dodge Co, N.Y., 1951
- J.M.RICHARDS, 'The Functional Tradition in Early Industrial Buildings', The Architectural Press, London, 1958
- A.ROSSI, 'A Scientific Autobiography' MIT Press, London, 1981
- A.ROSSI, 'The Architecture of the City', MIT Press, London, 1982, (Transl. from L'Architettura della Citta, by D.Chirardo & J.Ockman, Marsilio Editori, Padua, © 1966)
- A.ROSSI. 'Selected Writings and Projects', Architectural Design, London-Gandon Editions, Dublin, 1983
- ROYAL INSTITUTE OF INTERNATIONAL AFFAIRS, 'The Balcan States: A Review of the Economic and Financial Development of Albania, Bulgaria, Greece, Romania and Yugoslavia since 1919', Information Department, Oxford University Press, London, 1936
- JOSEPH RYKWERT, Gottfried Semper and the Problem of Style, A.D. 51, 6/7, 1981
- N.B.SALIVEROS, 'Commercial Bulletin: Prices of Building Materials in the Market of Athens and Piraeus (in Greek), ARCHIMIDIS, No 2, June 1908
- G.SARIGIANNIS, The Architecture in Greece and the Architectural Studies in Technical University of Athens, (in Greek), TECHNICA CHRONICA, Jul. Aug. Sep., 1977
- M.SCHAPIRO, Style, in A.L.KROEBER (Editor), 'Anthropology Today', The University of Chicago Press, Chicago-Illinois, 1953
- S.B.SCOPELITIS, 'Neoclassical Buildings of Athens and Piraeus', (in Greek and English), Gnosi, Athens, 1975
- G.SCOTT, 'The Architecture of Humanism', Methuen & Co Ltd, London, 1914
- G.SEMPER, 'Der Stil in den Technischen und Tectonischen Künsten oder praktischen Aesthetik', Friedr. Bruckmann's Verlag, Munchen, 1978, (© 1863)

- N.SIDERIS, 'Greek Industry: Industrial Production and its Value in 1953 and 54 in Comparison with 1939 and 1949', (in Greek), Athens, 1955
- C.SKARPIA-HEUPEL, 'The Morphology of the German Neoclassicism (1789-1848) and its creative Assimilation by Greek Architecture (1833-1897)', Doctoral Thesis, Aristotle University of Thessaloniki, 1976
- SOCIÉTÉ DES NATIONS, Etablissement des Réfugiés en Grèce, Genève, 1929
- E.G.W.SOUSTER, 'The Design of Factory and Industrial Buildings', Scott Greenwood & Son, London 1919
- P.STEADMAN, 'The Evolution of Designs: Biological Analogy in Architecture and the Applied Arts', Cambridge University Press, Cambridge, 1979
- H.STURM, 'Fabrikarchitektur, Villa, Arbeitersiedlung', Heinz Moos, Verlag, München, 1977
- D.SUGDEN, Factories, AD, No 2, 1974
- N.G.SVORONOS, 'Histoire de la Grèce Moderne', (in Greek as well), Presses Universitaires de France, Paris, 1972 (Themelio, Athens, 1976)
- M.TAFURI, 'Theories and History of Architecture', Granada, London, Toronto, Sydney, N.York, 1980 (© 1976)
- T.TASSOPOULOS, 'Greek Industry', (in Greek), Ed. Timfi, Athens, 1978
- TECHNICA CHRONICA, 'Report on the Use of Electricity in Athens for a Decade', (in Greek), 1 Jul. 1936
- TECHNICAL CHAMBER OF GREECE, 'Research on the Working Environment in the Industrial Sector', (in Greek), Permanent Committee on issues for Environmental Conditions, Athens, Sept. 1981
- TECHNICAL UNIVERSITY OF ATHENS, 'Guide of Studies', (in Greek), Academic Year 1950-1951, Vice President G.N.KORONEOS, Athens 31 Dec.
- TECHNIQUES & ARCHITECTURE USINES: ARCHITECTURE ET CONDITIONS DE TRAVAIL, Mai 1977, No 314

- I.D.TRIANTAFILLIDIS, 'Lessons of Architectural Design: Vol. 1, Industrial Premises', (in Greek), Chair of Architectural Design, Thessaloniki, 1977
- K.T.TRIANTAFILLIDIS, Problems of Introducing Prefabrication in Greece in 'Structural Prefabrication', (in Greek), Technical Chamber of Greece Ed. Prof. K.BIRIS, Athens, 1973
- H.G.TYRRELL, 'A Treatise of the Design and Construction of Mill Buildings and other Industrial Plants', The Myron C.Clark Publ. Co. Chicago, N.York, London, 1911
- P.TZONOS, 'Building Typology', (in Greek), Lab. of Architectural Design, Aristotle University of Thessaloniki, Greece, 1979
- P.TZONOS, 'Typology of Housing', (in Greek), Thessaloniki, 1983
- L.UTZ, 'Moderne Fabrikanlagen', Uhlands Technischer Verlag, Otto Politzky, Leipzig 1907
- T.VALAVANIDIS, Workplace Pollution and Problems of Health and Safety of Workers, (in Greek), SYCHRONA THEMATA, No 7, 1980
- H.V.D.VELDE, Counter-Propositions, DOCUMENTS, The Open University Press, 1975
- VIOLETT LE DUC, 'Dictionnaire Raisonne de l'Architecture Francaise', Paris: A Morel Editeur, M DCCCLXVI, Vol. VI
- VITRUVIUS, 'The Ten Books on Architecture' (Transl. by M.H.Morgan, © 1st cent.B.C.) Dover Publ.Inc., New York 1965
- A.VOURNAZOS, History of the Establishment of Technical University of Athens, (in Greek), TECHNICA CHRONICA, 1934
- WEBSTER'S NEW COLLEGIATE DICTIONARY
- F.WILD, 'Design and Planning: Factories', Van Nostrand Reinhold Company, N. York 1972
- J.WINTER, 'Industrial Architecture: A Survey of Factory Buildings', Studio Vista, London, 1970
- R.WITTKOWER, 'Architectural Principles in the Age of Humanism', Academy Editions, London, 1973

- I.ZIGDIS, The Industrialization of Post-War Greece and the Essential Role of UNRA, (in Greek), ECONOMICOS TACHIDROMOS, 6 Jan. 1972
- B.ZOGRAFOS, A.GIANNAKOU, 'Architectural Education: An Attempt to Record the Elements of its Content in the Architectural Department of the University of Thessaloniki in the period 1958-1978', (in Greek), Chair of Architectural Design, Prof. P.TZONOS, Thessaloniki, 1979
- X.ZOLOTAS, 'Greece in the Stage of Industrialization', (in Greek), Ed. by Bank of Greece, Research Works No 6, Athens, 1964, (© 1926)
- X.ZOLOTAS, The Beginning of Industrialization in Greece, (in Greek), ECONOMICOS TACHIDROMOS, 13 Jan. 1972

STATISTICAL SOURCES

Publications of the NATIONAL STATISTICAL SERVICE OF GREECE

- The Statistical Yearbook of Greece, 1930, 1937, 1965, 1968, 1970, 1974, 1976, 1978, 1980, 1981
- The Statistical Summary of Greece, 1954
- The Census of Industrial, Handicraft and Commercial Establishments, 1920, 1930, 1958, 1963, 1969, 1973, 1978
- The Economic Yearbook, 1938

LAWS, DECREES

LAWS

- | | |
|------------------------|--|
| ΓΝΛΔ' 19/21 Nov. 1911, | about 'The Health and Safety of Workers and the Daily Hours of Work' |
| 3741/1929, | about 'The Horizontal Property' |
| 616/1977, | about 'Fire Prevention' |
| 1568/18 Oct.1985 | about 'Occupational Health and Safety' |

PRESIDENTIAL DECREES

- | | |
|------------------|---|
| 22/29 Dec. 1933, | about 'The Health and Safety of Workers and Clerks in Every Kind of Industrial Establishment' |
|------------------|---|

12/17 Jan. 1934, about 'The Regulation on the Prevention
of Accidents in Open Air Works'

13/22 Mar. 1934, about 'The Health and Safety of Workers
and Clerks in Every Kind of
Industrial Establishment'

400/1976, about 'Fire prevention'

DECREES

38901/1976

380202/1976

17483/1978

17484/1978

about 'Fire prevention'